AGRICULTURAL ENGINEERING

The Journal of the American Society of Agricultural Engineers

OCTOBER 1928

ASAE

AGRICULTURAL ENGINEERING

Published monthly by the American Society of Agricultural Engineers
Publication Office, Bridgman, Michigan. Editorial and Advertising Departments at the Headquarters of the Society, Saint Joseph, Michigan

Subscription price to non-members of the Society, $3.00 a year, 30 cents a copy; to members of the Society, $2.00 a year, 20 cents a copy. Postage to countries to which second-class rates are not applicable, $1.00 additional. Entered as second-class matter, October 8, 1925, at the post office at Bridgman, Michigan, under the Act of August 24, 1912. Additional entry at St. Joseph, Michigan. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921. The title AGRICULTURAL ENGINEERING is registered in the U. S. Patent Office.

WILLIAM BOSS, President RAYMOND OLNEY, Secretary-Treasurer

Vol. 9 OCTOBER, 1928 No. 10

CONTENTS

AGRICULTURAL ENGINEERING

Vol. 9 OCTOBER, 1928 No. 9

The Harvesting of Corn Stalks[1]

By J. Brownlee Davidson[2] and Edgar V. Collins[3]

AN ESSENTIAL step in the utilization of corn stalks for industrial purposes is the development of methods which will insure an adequate supply of raw material at a reasonable cost. Those who are familiar with the problem of collecting a light material like corn stalks from the field, will appreciate how easy it is to make the mistake of assuming that the problem is easy of solution and that the cost of the raw material will be a matter of minor concern. As the large acreage of standing corn stalks in the corn belt is observed throughout the winter and early spring, it would appear to be a comparatively easy matter to secure a large quantity at a low cost. Corn stalks, however, are a bulky material and if an attempt to collect by hand methods were made the results would surely be disappointing.

For two years the department of agricultural engineering at Iowa State College has been giving some attention to the problem of harvesting corn stalks, and it is the purpose of this paper to report briefly the results of this work.

The first experiments were limited to using the corn harvesting machinery in common use on Iowa farms. They were carried out largely for the purpose of securing data which could be used as a basis of comparison. This method involved harvesting corn with the corn binder, husking the corn and shredding the stalks with the husker-shredder, and baling with the hay baler. The process was necessarily expensive on account of the large amount of hand labor involved. Carrying out this method, the bound bundles of corn fodder must be set into shocks after the corn binder, a laborious task. After curing the bundles are loaded and hauled to the husker-shredder, unloaded and fed to the husker-shredder by hand. After shredding the shredded stover is fed to the baler by hand.

These machines may be operated so the shredder will deliver shredded stover direct to the baler, saving time and labor. The cost of baling corn stalks by this method was found to be as follows:

Cutting corn with binder, per acre, including 6 lb. of twine at 15 cents, \$0.90; use of machine, \$0.50; horse labor, \$0.65; and man labor, \$0.50	\$ 2.55
Shocking, 2 2/7 hr. at 35 cents per hour	.80
Hauling (variable)	1.50
Husking-shredding	4.50
Baling, including wire	4.10
Total cost per acre	\$13.45
Credit for husking 40 bu. at 6 cents per bu.	2.40
Net cost per acre	\$11.05
Yield 1¼ tons of moisture-free corn stalks	
Cost per ton	\$ 8.85

Certain modifications would cheapen the process. In case of a large acreage a two-row corn binder, now manufactured in a limited way, could be used.

Another method involves the development of a special machine for snapping the corn and shredding the stalks in the field. The shredded stalks are left in the windrows and baled in the field. An experimental machine consisting of a remodeled ensilage harvester was tried out with fair success. The problem of collecting the shredded stover remained unsolved. This method, however, gave promise of reduced labor and lower cost.

An estimate of the cost of this method based on a yield per acre of 1¼ tons, 10 per cent moisture, is as follows:

Use of machine (cost estimated at \$1200, used on 150 acres) per acre per year	\$1.50
Tractor power	1.20
Tractor operator	.60
Labor, one man	.40
Hauling stover	1.50
Baling, including wire	4.10
Total cost per acre	\$9.30
Credit for picking 40 bu. at 6 cents in the field	2.40
Cost per acre	\$6.90
Cost per ton	\$5.52

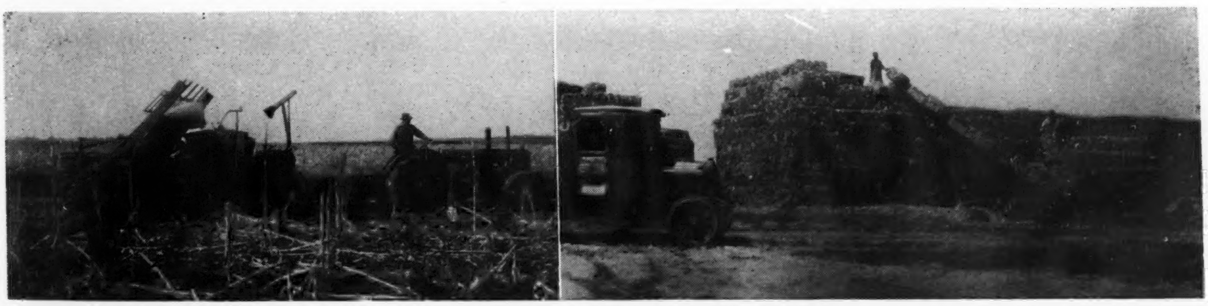
Still another method was conceived by Mr. Collins when trying to find some practicable method of collecting the shredded corn stalks in the method just described. In trying to arrange a baler to bale direct from the windrow, the thought occurred to him that a machine might be arranged to bale stalks direct from the windrow without shredding. Later mowing the corn stalks was substituted for heaping and raking.

The present outfit consists of a mower to mow the standing stalks, a rake to gather and deliver the stalks to the baler, and a baler to bale the stalks. The entire outfit is towed and driven by a tractor. This plan contemplates operation after the corn has been husked in the usual way.

[1]Paper presented at the Power and Machinery Session of the 22nd annual meeting of the American Society of Agricultural Engineers, at Washington, D. C., June, 1928.

[2]Professor of agricultural engineering, Iowa State College. Charter Mem. A.S.A.E.

[3]Agricultural engineer, Iowa Agricultural Experiment Station. Mem. A.S.A.E.



(Left) Equipment consisting of a mower, loader, and baler by which two men may bale standing corn stalks in one continuous operation. (Right) An inclined elevator for piling baled corn stalks

The most important advantages of this method are as follows:

1. It is the cheapest way of securing stalks, as a large amount of hand labor is dispensed with
2. It eliminates the expensive process of shredding. Factory specialists state that the shredding of the stalks will be of little value
3. It permits the farmer to pasture stalks for leaves and waste grain.
4. It may be carried out during slack periods
5. The stalks are harvested after being thoroughly dried out and the extra cost of handling the moisture eliminated. Stalks in the spring may contain as little as 10 per cent of moisture.

The disadvantages of this method are:

1. The yield of stalks is lower
2. They will contain more dust and dirt
3. It cannot be practiced when corn fields are soft and muddy, a condition that prevails when the frost leaves the ground in the spring.

This method provides for harvesting the stalks from the field during the winter and spring after the grain has been harvested in the usual way. The outfit consists of a mower to cut the standing stalks, a modified hay loader to gather and deliver the stalks to a baler, and a baler towed behind and driven by a tractor. This process is continuous and dispenses with a very large part of the hand labor. The machine was used on sixty acres with good success.

Estimate of cost, per acre, based on the results to date.

Cost of equipment with modifications

Baler or press	$565.00
Loader	135.00
Mower	86.00
Modification estimate	114.00
Total	$900.00

Annual cost, consisting of interest, depreciation and repairs	$200.00
Assuming 200 hr. use the cost per hr. will be	$1.00
Cost of tractor, 15-30 hp.	1.50
Foreman per hr.	1.25
Three men at 50 cents	1.50
Total cost per hour	$5.25
Cost per acre (⅖ ton of stalks)	$2.10

Cost of harvesting by the last method.

1927 Results

Cost per acre (⅖ ton of stalls)	$2.10
Cost per ton	$3.15
1928—Actual cost of operation per hour of four-man machine	$4.35

A new machine was developed in 1928 having a self-feeder and self-threader, reducing the number of men required to two, and costs, under best working conditions, to the following:

Labor	$1.00 per hour
Power	1.25 per hour
Wire	.45 per hour
Machinery	.50 per hour
	$3.20 per hour

Cost per ton assuming harvesting at rate of 1⅓ tons per hr., $2.40.

The investigations and experiments conducted to date, together with estimates of probable factory value of corn stalks, would indicate that with efficient organization and management corn stalks may be collected at a practicable cost and in sufficient quantity to meet factory demands.

Concrete Drier for Artificially Curing Alfalfa

By N. S. Grubbs[1]

TO MAKE hay when the sun shines is a satisfactory method of curing alfalfa—when the sun shines. But many times the sun fails to shine when it is needed to do its part in making hay. Joseph H. Fulmer, a farmer operating a 620-acre farm near Nazareth, Pa., is working out a method that will cure 100 per cent of his crop on days when it suits him regardless of weather conditions.

Mr. Fulmer is building an alfalfa drier that will not burn or rust away, nor will it need paint. Fortunately, too, rats will not find this drier a comfortable home. The drier is made of concrete throughout and is unique in its plan and method of operation. The plant depends upon artificial heat for operation and is supplied by burning a cheap grade of hard coal in specially designed furnaces. Four furnaces will be called upon to supply hot air when the drier is in full swing.

In general, the drier consists of a monolithic concrete flue lying horizontal on the ground, 200 ft. long, 10 ft. wide and 3 ft. high. At intervals of 40 ft. is a 1x10-ft. opening through which heat will pass into the room above which has the same length as the flue, but is 6 ft. high and, of course, 10 ft. wide. The drying room above has cinder block walls and a solid concrete flat roof.

An endless chain conveyor will receive a mat of alfalfa cut in short lengths and slowly carry it over the inlet vents of the flue to the opposite end of the building, giving the alfalfa sufficient time to dry out on its journey from one end of the building to the other. The dry alfalfa will then be stored in large barns or made immediately into alfalfa meal and placed into bags for home consumption or sold.

Cinder blocks were selected for the drying room since

[1]Field agricultural engineer, Portland Cement Association. Mem. A.S.A.E.


(Left) An end view of the flue in the Fulmer alfalfa drier showing concrete block at its side which will later be used for the drying room which will be 200 feet long, 10 feet wide, and 6 feet high. (Right) A view of the ovens and fan of the Fulmer drier

they are fireproof and have a high resistance to heat loss. Mr. Fulmer also claims the whole plant was economical to construct and that it is permanent. The grinding and power to move the machinery will be gasoline power driven. A large fan is being installed to propel the heat through the flue and afford an air current to carry away the moisture that will be eliminated from the stems and leaves of the hay.

Mr. Fulmer has kept construction costs low. Local materials have been used and farm labor did the work. Likewise operating the drier can be done with five or six men since machinery will be employed to cut, load and haul the hay to the drier. Improved machinery including tractors will be employed to the limit.

At present, Mr. Fulmer has 245 acres of alfalfa coming along and his plans call for 500 acres of alfalfa by this time next year. He foresees a profitable business in raising this high protein hay and in placing it on the eastern market in convenient form for the dairymen, poultrymen and general livestock feeder.

The drier will also be used in the fall to prepare seed corn for winter storage. In some years the corn-growing season is short and early frosts cut short the maturing weather. This new device will be made to do its share in getting the seed corn into condition to carry over the winter months.

As time goes on Mr. Fulmer expects to find other uses to which he can put the drier other than to cure alfalfa and season seed corn. One thing is sure, however, Mr. Fulmer has a well-constructed, permanent drier, which aside from operation costs will have little or no depreciation.

Cobblestone for Building Construction

By W. H. McPheeters[1]

COBBLESTONE is not necessarily a new form of building material, but to most sections of the country it would appear to be new as it is not in common use. The possibilities of cobblestone for future buildings are unlimited in sections where there is plenty of hard rock that is suitable for the work. In fact, any rock that is hard, either small field stone or massive limestone and granite that can be broken into small, irregular pieces, is suitable for cobblestone work.

Buildings made of cobblestone are both beautiful and attractive. Very artistic buildings may be constructed of it. It is possible, in sections where rock of various colors can be had, to work out color schemes or to make the main building of one color and use another color for decorations, such as the water table, window or door decoration and porch columns.

Buildings made of cobblestone in addition to being beautiful are permanent. There is no painting or repair work on the walls. They are massive and, consequently, less liable to be destroyed by wind. By putting on a permanent roof they are fireproof and in most cases, where rock and sand is plentiful, the first cost is as little or less than a cheap frame building.

Another advantage of cobblestone buildings is that almost anyone can construct them and do the work, a little at a time, to fit in with his regular work. In Oklahoma there are thousands of farms and many small towns where rock is so plentiful it is a nuisance, and in many of these places sand can also be obtained for the hauling, or for a very small sum. I presume most of the states have rocky sections where suitable rock is abundant.

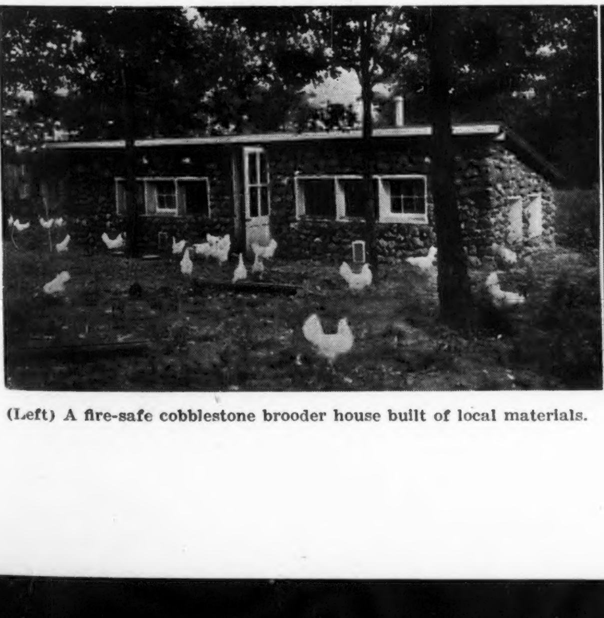
There are several types of cobblestone construction; in fact, it is possible to use almost any form of rock. I shall discuss first walls made of field rock, that is, small rock gathered from fields and pastures. In this case rock of about the proper size can be gathered up and hauled to the desired building site at odd times. It is also well to have them piled up ahead of time so that rains will wash them, as it is necessary to have the rocks clean. There are three general types of field rock in Oklahoma, namely, the irregular nugget of flint, limestone and granite, the flat, thin limestone, and the round boulders of granite. Each of these will make a distinct type of wall.

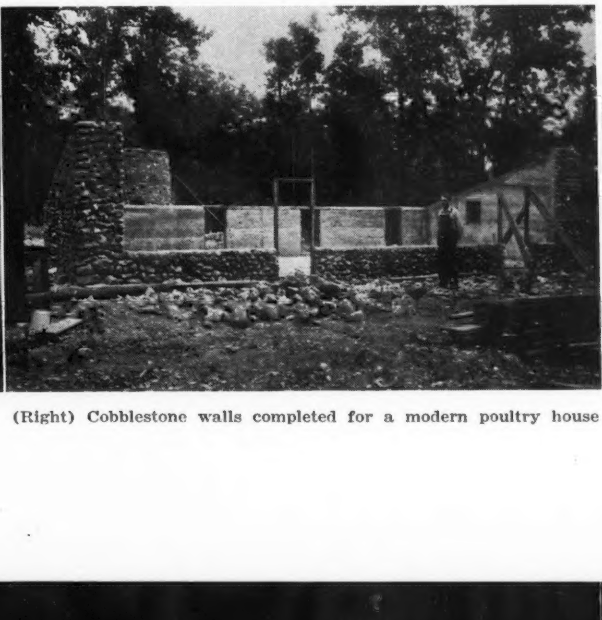
The irregular chunk flint, limestone and granite work up into the regular rough cobblestone work. In this type of work the rock projects about 2 in. beyond the mortar, which, by the way, is really concrete as it is composed of cement, sand and gravel. The joints are raked out with a trowel but not brushed. If desired, however, these joints may be brushed with a whisk broom making a little neater job and assuring that all mortar is washed off leaving a neat, clean surface.

It is also possible to make a pointed joint work with these rock. In this case two types of mortar must be used, the outer face of rock being laid in a cement—sand (1:3 mix) mortar and filled in behind with a 1:3:3 mix of cement, sand and gravel or crushed rock, care being taken to see that the concrete fills all spaces. This joint may be beaded, giving it an attractive appearance similar to the ashler work, but the rough appearing cobble work is the easier to construct and more like nature's work. Consequently, where the landscape is of a rocky nature the rough cobble work is in keeping with the surroundings and wherever started has become very popular. Never lay the rock in rows, rather make them look as though they have been put in by the use of a shot gun.

Another field rock that works up into a very attractive building is the flat, thin limestone. In many sections this

[1]Field agricultural engineer, Portland Cement Association. Mem. A.S.A.E.





(Left) A fire-safe cobblestone brooder house built of local materials. (Right) Cobblestone walls completed for a modern poultry house

This picture shows a section through a finished cobblestone wall. Note how closely the concrete and stone are bonded together and the smooth surface obtained on the inner wall

limestone has sharp edges, the sharp edges being laid so that they project out beyond the mortar, and the joint rubbed with a whisk broom. This makes a very attractive building. These flat rocks may be broken and the broken edge laid out projecting an inch or so beyond the mortar.

Another type of field rock is the round boulder. In Oklahoma, we have sections of round boulder granite. They look as though they are of glacial formation. These are laid similar to the rough wall with the rubbed joint. It is almost impossible to keep them out of rows so we lay them in rows similar to brick. They make a fairly attractive building, but one grows tired of the uniformity, too much the same, like a wall of one-colored brick.

The next great type of rock work which is really a form of cobblestone is the broken rock, any hard rock—limestone, granite, flint, conglomerates and flint-like sandstone. Large rock may be broken into small irregular-shaped pieces and laid similar to the rough irregular field rock either with a rubbed or pointed joint work. This type of wall is very attractive especially when constructed of highly colored rock. This type of work looks good anywhere while the rough field cobble appears much more attractive when used in a country with a rough, rocky scenery.

I shall not attempt to give details of construction, as this should be done by use of pictures and drawings, but I will give a few hints as to how the work is done. A form of some sort is used on the inner side of the wall. A solid board wall may be erected, but as this requires a lot of form lumber, I use 2x4-in. studding about 3 ft. apart. (These are any desired length, whatever length is needed for rafters or some other construction work.) Then I use a 1x12-in. plank or two pieces of shiplap nailed together. Lay one course of rock all the way around the building, then raise this board and lay another course and so on. The interior of the wall will appear like a monolithic concrete wall which may be plastered.

I also have a form worked up, with which I build an air space cobblestone wall. I use it especially when using sand rock for cobblestone work. This cobble wall requires a little more material and works a little slower than the solid wall. When the rock is hard and impervious to water, there is really no need of the air space wall, in the South, if the wall is about one foot thick, as very few cases have been found where the walls sweat. In the North where the weather gets cold and stays cold for long periods of time the air space wall may be better. The wall may be furred and lathed to form an air space for insulation from the cold.

An attractive farm bungalow of cobblestone construction

Just to give an idea of the real possibilities of cobblestone work I shall give results of a few demonstrations in Oklahoma. About two and one-half years ago I held a few demonstrations in the northeast corner of Oklahoma where flint-rock and flint sand and gravel are so common that they are looked upon as a nuisance. About two months ago I drove along the highway in this section of counted twenty-seven buildings of cobblestone. These are the ones I could see from the road, I do not know how many others are up in those hills. I also found out that quite a number of these buildings have been built by the owners themselves. Since starting the work in this section I have held demonstrations in other sections of northeast Oklahoma and the work has begun to grow in nearly every case. This summer I held a few demonstrations in central and southwest Oklahoma and am hoping for the same results. I feel sure they will come as most of the material is free, the labor so easily learned, and one can utilize his spare time to such a good advantage. In fact, anyone with this material at his command would be foolish to build of anything but cobblestone.

EDITOR'S NOTE: If details of cobblestone construction are desired, a comprehensive bulletin on the subject can be had by writing the Portland Cement Association, 33 West Grand Avenue, Chicago, Illinois.

Make Corn Stalks Profitable

WHAT to do with the corn stalks, whether to burn them, to plow them under, to feed them as fodder or stover or to put them in the silo has been a subject of more or less debate for some time. Naturally, livestock feeders are anxious to get the greatest possible feeding value from the corn plant and at the same time to keep their soil productive and fertile.

Few tests have been made to indicate the actual fertility value of corn stalks from the standpoint of increased crop yields. It is not enough to analyze a sample of corn stalks from the standpoint of increased crop yields. It is not enough to analyze a sample of corn stalks in the laboratory for nitrogen, phosphorus and potassium content and to calculate their value on that basis. The only accurate test of their value is that of comparative crop yields on plots which are similar except for the method of handling the stalks.

Plowing under a ton of corn stalks in a 10-year test at the West Central Experimental Station in Minnesota increased wheat yields 1.3 bushels per acre, while two tons of stalks increased the average yield from 17.9 bushels on soil receiving no residues to 20.2 bushels, a difference of 2.3 bushels which at $1.25 per bushel amounts to $2.87, or $1.43 per ton of stalks.

Figuring silage two-fifths as valuable as alfalfa hay and the latter at $20 per ton, silage has a feeding value of $8 on the ton basis. Approximately one-third of this feeding value comes from the stalks which then are worth some $2.75 per ton, as feed and the yield of stalks as silage is always much greater than in the dry form.

Authorities on crops and soils tell us that about three-fourths of the fertility value of the corn stalks is returned as manure when the silage is fed to livestock.

Rural Electric Line Built for $333 per Mile

By Geo. W. Kable[1]

AN INTERESTING experiment in rural line construction has been taking place near Portland, Oregon, during the past six years. The experimenter and the designer of the line is D. S. Young, of Sherwood, Oregon.

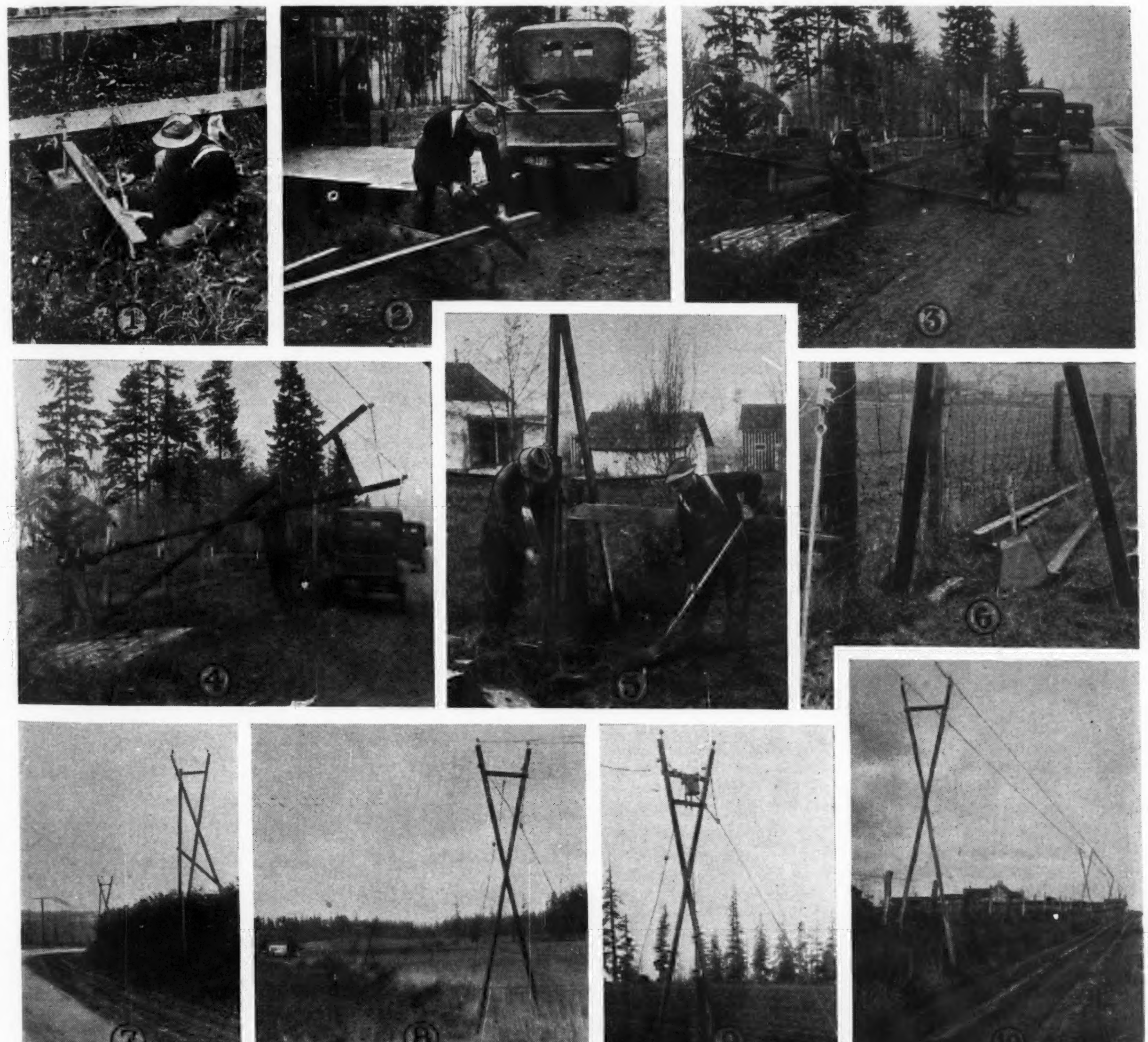
Compelled by economic necessity to build lines at the lowest possible cost, Mr. Young abandoned the standard pole construction and substituted for it a line supported on flexible X frames made of 2x4's, and hinged at the base.

The lines on this system carry 2200 volts, use standard hardware, and comply with the minimum requirements. Some of the lines have been in use for six years and are still in good condition. I am advised that the cost of the lines built in recent months has been as low as $300 per mile.

The X frame is the distinguishing feature of the Young line. Intermediate frames are made up of two 2x4's, and anchor frames of 3x4's bolted together near their centers with ⅜-in. iron bolts, as shown in the accompanying drawing. A cross member is bolted near the top. The frame is supported on two 1-in. iron pipes embedded in pyramidal concrete foundation blocks.

Anchor frames are placed at intervals of about one-quarter

[1]Agricultural engineer, Oregon Agricultural Experiment Station. Mem. A.S.A.E.



Several views of the Young flexible X frame for rural electric line construction. (1) Method of measuring to locate hole in the long leg of the frame. (2) Cutting off the long leg after boring bolt hole. (3) Line wires being tied to the insulators; the Ford is placed to help hold the line. (4) Lifting frame after wires are tied to insulators. (5) After the frame is bolted to the iron pipes in the foundation blocks the latter are trued up and earth tamped around them. (6) Base of frame bolted through iron pipe in anchor blocks; the wood legs are cut off above ground. (7) A side hill frame showing unequal length of legs and bracing for the line on a curve. (8) Frames placed astride a drainage ditch. (9) An anchored intermediate frame for transformer and service extension. (10) Typical section of the Young distribution line along a country road

mile, at road or line crossings, at transformer stations and where the line changes direction sharply. Frames are anchored to concrete dead men through anchor rods, strain insulators and one-quarter inch cable attached to the frame cross member near the top.

No lateral guys are used on the frames. On slight curves the frames are stiffened by vertical tension members which carry the side pull to the foundation blocks. On sharper curves three foundation blocks are used, causing the resultant forces to still fall within the base of the frame and make it self-supporting. Where a service lead runs from a frame, the transformer is hung to one side of the center of the cross member to balance the pull of the service line. No attempt is made to place foundation blocks on the same level. On hillsides, one leg of the frame may be 6 or 8 ft. longer than the other.

Much of the saving effected by this type of construction is in reduced labor costs. The actual operations in erecting the line are therefore of interest.

Concrete foundation blocks are cast in quantities in the yard. Foundation blocks and lumber are then delivered along the road where the line is to be built. Shallow holes for the footings are dug by contract labor. The company Ford hauls the wire, bolts, tools and the line crew, consisting of two men.

In putting up a section of line the dead end or anchor frames are erected first. One line is then laid from dead end, Frame No. 1, to dead end, Frame No. 2. The ends of both wires are securely tied to the insulators on Frame No. 2, using a light extension ladder for climbing the frame. The second wire is then laid back to Frame No. 1, and both wires stretched reasonably tight with block and tackle and tied to the insulators on Frame No. 1, again using the extension ladder. Returning to Frame No. 2, the intermediate frames are put up as follows:

On ordinary construction with 18 ft. minimum clearance, intermediate frames are made of 2x4's one leg 20 ft. long and the other leg 22 ft. long. All framing holes, except the anchor hole at the base of the longer leg, are spaced by a templet. The members are then bolted together in the center and the cross brace bolted on by one of the men. The foundation blocks are set loosely in the holes by the other man who measures the height of the hole in one foundation pipe above the level of the hole in the other by using a level, straightedge and rule. This distance is marked on the unbored leg of the frame, the hole bored and the leg cut off to fit the ground. By making this allowance for difference in height of the footings, the frame will stand plumb in one direction when erected.

While this is being done the first man wraps a marker around each line wire directly over the foundation blocks and screws the insulators on the pins.

The frame is now laid on its side with its base near the footings and its top in the roadway. The line wires are pulled out to the insulators and tied in at the points marked, making allowances for slope of ground and wires. When the frame is released, the tension in the wires lifts the top clear of the ground and one man stands it up.

One leg of the frame is then set on a board above a foundation block and the other one is lifted and held in place while the second man bolts it to the foundation pipe. The supporting board is removed and the first leg bolted to its pipe by one man, the line holding the frame vertical during the bolting process. The foundation blocks are then trued up and dirt tamped around them.

After the last intermediate frame is erected, the extension ladder is again used to climb the No. 1 anchored frame. The excess slack is pulled out of the line, which is then tied securely. No climbing is done except at the anchored frames.

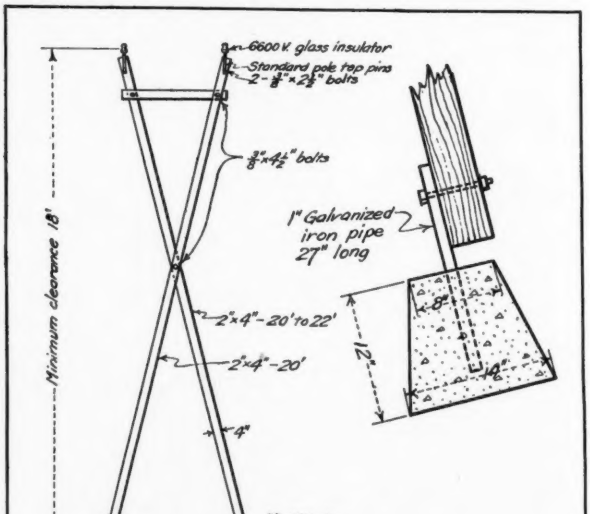
Mr. Young and one other man (both farmers) will erect one-half mile of straight line completely in one day after foundation holes have been dug and material delivered on the ground.

Cost figures for the construction of nine miles of line in 1925 are as follows:

Anchor rods	$ 51.50
Bolts	68.08
Cable	29.85
Cement	119.00
Copper (Nos. 6, 8 and 10)	887.24
Cutouts	20.00
Clevices	22.20
Gravel and sand, at $2.75 per yd.	75.00
Guy clamps	41.26
Glass insulators	50.52
Eye bolts	17.15
Strain insulators	53.70
Lumber at $18, $20 and $22 per M	262.45
Pole top pins	120.50
Pipe for foundation blocks	169.16
Washers	16.74
Reinforcing for anchor blocks	10.00
Total	$2014.35
Plus 10 per cent	201.43
Total material cost	$2215.78
Total labor cost (Includes clearing right of way, assembling materials, cement work at 60 cents per hour, digging foundation holes at 20 cents each, and two men erecting line at $5.00 and $4.00 per day.)	713.30
Insurance	39.81
Freight	35.00
Total cost of line	$3003.89
Total cost per mile of line	333.76
Material cost per mile	246.20
Labor, insurance, freight, etc., per mile	87.56

Costs of individual structures are given by Mr. Young as follows; these are total costs for frames erected in place and include all labor and material except for clearing right of way and for copper:

Intermediate frames	$ 6.00
Light turn and service drop frames	6.90
Heavy turn frames	9.00
Transformer and intermediate anchored frames	10.05
Dead end frames	12.45
Transformer and heavy turn frames	12.75



Drawing showing details of the Young flexible X frame used in rural electric line construction

Mr. Young has not constructed his flexible line without criticism. On first thought the 2x4-in. frames seem dangerously flimsy, and the hinged base a travesty on the creosoted pole. Such a radical change must also offend the eye of many who have grown up with pole lines. The seeming unsightliness of the frame line diminishes as the novelty wears off, and I am not sure that it might not eventually compete with some pole lines along country roads in esthetic value.

The Oregon Public Service Commission, while not having passed formally upon this type of construction, has the following to say regarding it: "This type of construction was called to our attention previously through an informal complaint, and a field inspection was made by our engineering department . . . . Sections of line using this class of construction were found to be giving satisfactory service after many years.

"Will further advise that additional study of this matter indicates that insofar as construction requirements prescribed by this Commission and contained in the National Safety Code are concerned, this type of supporting structure meets all rules and regulations prescribed for rural line construction."

Obviously, the greatest use which the frame construction might be expected to serve would be for the secondary distribution lines and perhaps for private farm extensions where low first cost is desirable and unskilled workmen available. It at least offers a possibility worthy of consideration in the program of rural electric line extensions.

Grinding Feed With Electric Power[1]

By F. J. Zink[2]

GRINDING is the most important problem of feed processing for livestock and for dairy and poultry production. It is a major problem for the application of electricity to agriculture.

C. D. Kinsman states in Bulletin No. 1348, of the U. S. Department of Agriculture, entitled "Appraisal of Power Used on Farms of the United States," that from 10 to 30 hp-hr. are utilized for each 100 bu. of feed ground. He estimates that 200,000,000 hp-hr. are utilized annually for grinding feed. This then represents from 666,000,000 to 2,000,000,000 bu. ground annually. The horsepower used represents 4.3 per cent of the total annual cost of power developed on farms and it has a value of $129,000,000. The value of power produced by the public utilities of the U. S. in 1926 was about nine times that of the estimated cost of grinding power utilized. However, the quantity of power produced by utility companies is 460 times that utilized in doing the grinding on farms of the United States. It is obvious that we are paying too much for our present grinding power. These figures are based on a 1926 power and light utilities revenue of $1,684,000,000 and a total of 92,000,000,000 hp-hr. generated.

The livestock and dairy sections use the major part of the grinding power utilized. The use of ground feed has greatly increased in the past few years, and I believe that the above figures of horsepower-hours utilized and bushels ground are greatly exceeded at the present time.

The problem presents itself as to just how best to grind these one to two billion bushels of grain. What is the most economical process of doing this grinding? Is it cheaper for the farmer to have his feed ground by commercial or custom mills, or should he do it on his farm? If he does it on his farm, about what equipment should be utilized? These seem to be important questions before us. We agricultural engineers should feel the responsibility of this freedom.

In various tests made on grinding feed on farms of the Iowa Project on Rural Electrification we have obtained the results shown in the accompanying table.

An attrition mill checked at Bennett, Iowa, using two 40-hp. electric motors and 30-in. grinding plates showed the following results:

[1]Paper presented at a meeting of the North Central Section of the American Society of Agricultural Engineers at Ames, Iowa, May, 1928.

[2]Assistant agricultural engineer, Iowa Project on Rural Electrification. Assoc. Mem. A.S.A.E.

Grain ground	Hp-hr. per 100 bu.	Quality of work
Shelled corn	48.0	Very fine
Ear corn	61.0	Medium fine (crushed and ground)
Ear corn and oats (⅔ corn, ⅓ oats by weight)	31.2	Coarse (corn crushed, mixed with oats and ground)
Oats	41.4	Very fine (pig feed)
Oats	36.5	Very fine (pig feed)
Oats	46.8	Very fine (pig feed)

Test made January 1924

Without drawing conclusions from these results I believe that it has been accurately stated that small mills will grind as efficiently as will large mills. This makes it practical for the individual farmer to use small grinding outfits operating as economically as custom mills.

The advantages of electric power for grinding on the farm are: (1) Extreme convenience in operation, (2) little attention required when in use, (3) no attention required when not in use, (4) large overload capacity, and (5) motor speed suitability for direct connected installations. The disadvantages are: (1) Cost of central station current, (2) the lack of a general distribution of public service in rural areas, and (3) impracticability of using current from isolated plants for grinding purposes. The first and second disadvantages are being corrected with more and more rural service lines being built and better rural rate schedules adopted.

The use of electric power for grinding on farms is important because of its ability to lower costs and to increase the electric energy consumption on the farm thereby making lower rates possible.

Electric rates developed for rural service vary greatly. Where amounts of about 150 kw-hr. are used per month the newer rates range from 8 to 12 cents per kw-hr. Assuming 10 cents per kw-hr. for power, fixed charges on motor and grinding equipment at 13 per cent annually and 40 hp-hr. required for each 100-bu. unit ground, Fig. 1 compares small grinders and motors operating practically without attention and large grinding equipment using 3 to 5-hp. motors and requiring an attendant. The chart also shows the cost of grinding at a custom mill at a grinding rate of 12.5 cents per 100 lb. haulage at 16 cents per gross ton-mile and labor cost of $1.60

Data from Iowa Feed Grinding Tests

Grain ground	Hp-hr. per 100 bu.	Type of mill	Capacity per hr., lb.	Diameter of burrs, in.	Motor hp.	Quality of work
Oats	27.5	Crusher and burr	586	8	5	Coarse
Oats	35.4	burr	102	4	1	Medium fine
Oats	21.5	Crusher and burr	970	8	5	Coarse
Oats	48.8	Crusher and burr	372	6	5	Medium fine
Oats and barley (half and half)	37.0	Crusher and burr	470	8	3	Medium fine
Barley	41.5	Crusher and burr	799	6	5	Medium fine
Barley	35.0	Crusher and burr	875	8	5	Coarse
Barley	40.0	burr	190	4	1	Medium fine, new burrs
Ear corn	59.0	Crusher and burr	675	6	5	Medium fine
Ear corn	40.0	Crusher and burr	840	8	5	Medium fine
Ear corn	36.6	Crusher and burr	1160	8	5	Medium fine

Checks were made during the winter of 1927-28

per 100 bu. The average haul to town in the west north central section of the United States is 7.6 mi. I have assumed a 5-mi. average haul for the chart.

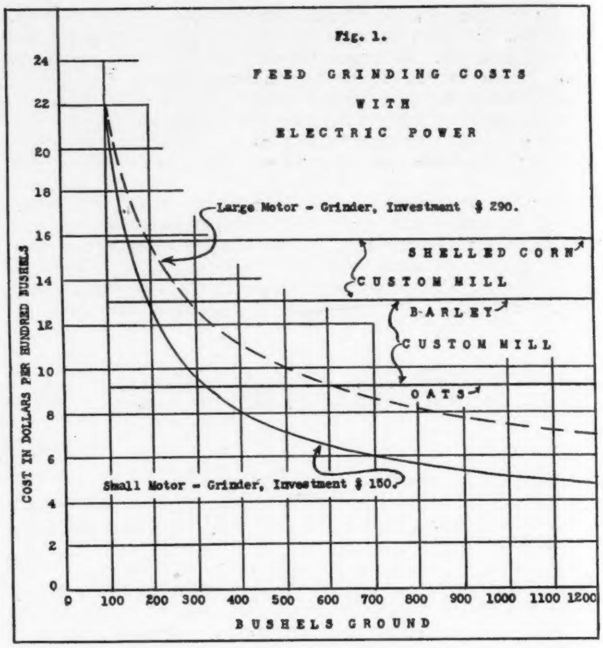
The comparison shows that the farmer who needs only one or two hundred bushels ground annually should have it done at a custom mill if within a reasonable hauling distance. A farmer requiring more than four hundred bushels ground per year can well afford to own his own equipment and do the grinding work on his farm. Home-grinding costs approximately one-half that of custom-mill grinding when more than seven hundred bushels are ground annually.

Of the two types of home grinding the small mill will operate from 25 to 35 per cent cheaper than the large equipment. There remains the problem of further developing these small outfits to handle ear corn automatically as well as other grains.

From all points of view when improved for automatic or semi-automatic operation the small equipment is superior to the larger equipment. It is cheaper to operate, a lower capacity transformer may be used, it gives a greatly improved load factor and aids in the improvement of the demand and diversity factors of rural distribution lines.

Hammer mills are coming into more general use. I believe that farmers with tractors and without electricity can utilize the large mills of this type when they have sufficient grinding to operate the mill economically. Large hammer mills are impractical for electric power on the average individual farm because of their great power requirement. Small hammer mills are adaptable to electric power for grinding oats, barley and shelled corn. Improvement on them for handling earn corn is necessary. Improvements are also necessary so that the mills will self-feed without clogging and the screens will not clog with hulls and flour. Small hammer mills are not meeting general approval because of these defects.

Electric power is a thoroughly practical application for feed grinding.



Some Economy Measures on Rural Lines

By Geo. W. Kable

THE designer, D. S. Young, of the flexible X frame used in the rural electric line construction described in the article on page 305, has adopted some practices which may be suggestive at least to small distribution companies. Eight years ago he purchased six miles of rural distribution line, which was in bad financial condition and threatened with abandonment. In endeavoring to maintain and extend these lines, and give reasonably good service, he was forced to measures of economy which stimulated originality. For instance, he reads meters once every three months, presents the bill on the spot, discusses any difficulties or contemplated equipment the user may have in mind, and in 90 per cent of the cases collects the bill. The meter book, including detachable bill form, comprises the entire bookkeeping system. These economy measures, including his flexible frame line construction, have resulted in reductions in first cost and overhead sufficient to permit service in territory which under a more costly system would probably be without electricity for many years.

Solid Carbon Dioxide as a Refrigerant

SOLID carbon dioxide, which has a Fahrenheit temperature of 109 to 114 deg. below zero, has long been known as a scientific curiosity, but as a result of better and cheaper methods of manufacturing, it has recently received much attention as a possible commercial refrigerant for railway cars, cold storage rooms and ship holds. A great deal has been published in the popular press to the effect that it is capable of working wonders in all lines of refrigeration.

Its great cooling power and its freedom from drip are interesting and attractive features but the fact seems to be overlooked that the carbon dioxide gas given off by the new refrigerant may under certain conditions be distinctly harmful to fresh fruits and vegetables.

When removed from the parent plant or dug from the ground, fruits and vegetables are still alive and remain alive during shipment and storage and as long as the fresh product is in a marketable condition. Like other living material, either plant or animal, they are carrying on respiration, taking up oxygen and giving off carbon dioxide, and they can not stand great and prolonged changes in the oxygen or carbon dioxide content of the surrounding air. It has been well established in botanical literature that continued exposure of peaches, pears, apples, strawberries or cranberries to high percentages of carbon dioxide will result in the development of objectionable flavors, and it has been shown that certain storage troubles of apples and potatoes are the result of an accumulation of carbon dioxide and the displacement of oxygen. Heavy losses in overseas shipments of apples and pears have been found to be caused by an excessive accumulation of carbon dioxide in the hold of the ship.

With these facts in mind it is evident that the use of the new refrigerant can not be considered as merely a problem in physics and refrigeration but, in so far as the shipment of living material is concerned, is largely a question of the tolerance of the particular fruit or vegetable to the accumulation of carbon dioxide in the storage air. This tolerance varies with the variety and maturity of the product and our present knowledge of the subject is far too meager to serve as a basis for commercial procedure. Under such conditions indiscriminate popularizing of the new refrigerant is untimely and may have dangerous possibilities.—Dr. Charles Brooks, U.S.D.A. Bureau of Plant Industry.

The Control of Heat and Ventilation in Sweet Potato Storage Houses[1]

By S. P. Lyle[2]

THE title of this investigation might at first seem too inclusive in its scope, if a person envisages the solving of a multitude of the unknown factors in connection with the curing and storage of sweet potatoes. The problem arose through the necessity for determining the limitations in building alterations which would insure safe and successful curing of sweet potatoes in remodeled warehouses and storage buildings. Since the curing procedure which insures the production of the highest market quality sweet potatoes is well established, we did not divert our attention with the interesting horticultural problem of determining the reactions of the potatoes and the agencies destructive to them under various temperature and humidity conditions, but confined our operating conditions to the optimum ranges for high quality production.

Our problem then was limited at the outset in its scope to the investigation of the influence of certain uninvestigated factors of design on the positive control of temperature and humidity within the optimum range in natural draft houses. Since reliable data within the practical operation limits of the sweet potato curing process are available for computing the transmission of heat through various types of wall construction, the consumption of fuel per pound of water evaporated, and the size of openings required for given rates of air change, we did not isolate these or other factors for investigation, but studied the correlation of these factors in the operation of a house as a unit, and this study may be more accurately defined as far as it has progressed as an examination of the thermal and dehydration characteristics of various combinations of design factors.

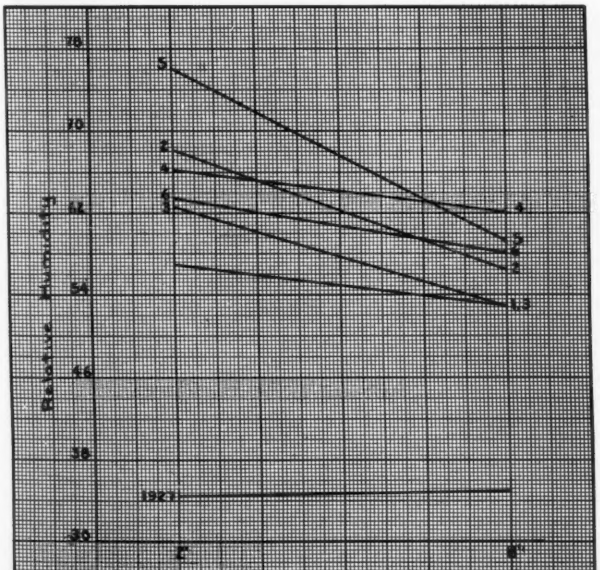
This investigation has been conducted by R. L. Keener of the horticultural division and W. E. Broach and myself of the agricultural engineering division of the Georgia State College of Agriculture. The past winter was the third year of its progress. A crop of sweet potatoes was successfully cured last winter and the preceding winter. It should be noted however, in this connection that all of the characteristics of the house designs in these two trials were not favorable to the maintenance of optimum curing conditions. The proper conditions were maintained for the successful curing of the crop, however, through the diligence and skill of the operators Mr. Broach and Mr. Keener. The inefficiencies then are noticeable chiefly through an unusual amount of attention required in draft regulation.

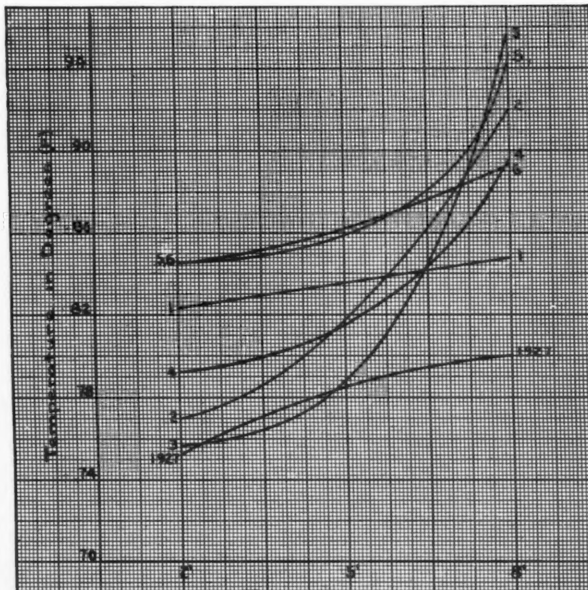
During the first winter this experiment was conducted, no sweet potatoes were used in the test, as it was decided to run five preliminary tests for comparative purposes before the actual curing tests were conducted. No more than one curing test can be run per year, but by simulating the operating conditions we were able to investigate the heating and ventilation characteristics of six designs of natural draft houses, in one house in five months. Only one of these tests was on a type of design in common use. Another was an improved type developed by our extension engineer, Mr. Broach. The other four were special designs to enable us to study the results to be expected from certain features of design. These main features included (1) two types of ceiling, flat and sloping; (2) two types of exhaust ventilators, Rutherford and King; (3) two positions of the stove, above the floor and below the floor; (4) two methods of intake, cold and heated, and (5) two methods of circulation, natural convection and distribution by pipe.

These factors were incorporated in combinations which brought the most important ones into use at least three times, and enabled us to study the effects attributable to each of these factors although the measurements of these influences must be tested and repeated under actual potato

[1]Paper presented at the structures session of the 22nd annual meeting of the American Society of Agricultural Engineers, at Washington, D. S., June, 1928.

[2]Professor of agricultural engineering and head of the division, Georgia State College of Agriculture, University of Georgia.





curing and storage conditions. Each of these preliminary tests was conducted for a continuous period of one hundred hours. The first six hours of each test were used to stabilize as nearly as practical the operation of the house to the optimum conditions desired for sweet potato curing.

At the end of the six-hour stabilizing period data was recorded at three-hour intervals and also continuously by instruments for four days on each of the six tests. In each test the operators endeavored to maintain the optimum operating conditions. The data recorded were the test number and title, the recorder, the date and hours, the outside temperature, humidity, wind direction and velocity and remarks on the weather, the inside temperature in six fixed positions on each of the three levels two feet, five feet and eight feet, respectively, above the floor level (a total of eighteen readings to indicate uniformity of temperature distribution), three pschycrometer readings at the two-foot level and three at the eight-foot level to indicate uniformity of relative humidity, air temperature and velocity in each intake and exhaust flue, and a record of water evaporation and fuel consumption.

Each of these tests and those in the actual curing of the 1926 and 1927 crop of sweet potatoes has been conducted in the same house which was altered before each test in accordance with our project plan. The house is 16x32 ft. and represents the one carload unit in a large storage shed.

For the benefit of persons not familiar with the handling of this crop, I will describe briefly the method practiced in Georgia. The crop is allowed to mature before harvesting, which usually occurs in early November. The grading is preferably done in the field, to eliminate extra handling, reduce bruising and minimize decay. If this operation is carefully performed no regrading should have to be done until the potatoes are removed from storage for marketing, at which time they should be graded in accordance with the U.S.D.A. marketing standards. The storing of crates in the potato shed should be done as rapidly as possible and should not exceed three days in a one carload unit, as the fire must be started about two days before the potatoes are placed in the house, and hence the first stored might be dried excessively. To compensate for a difference in curing time the first crates should be placed over the floor area before stacking up, thus combining the effect of their longer curing period with the lower temperature usually found near the floor. The fire is maintained continuously and all ventilation openings are kept as wide as the weather permits during the entire curing period, which usually is about ten days in length. A curing temperature of from 80 to 85 deg. F. is considered best. During this period the potatoes lose approximately 6 per cent of their initial weight through evaporation of water. When the skin of the potato has a soft velvety feel the fires may be discontinued. Another indication of sufficient curing is the presence of tiny sprouts on some of the potatoes. After the fires are discontinued, the temperature should be lowered to from 50 to 55 deg. and maintained as nearly as practicable within that range. The house should also be opened once or twice each week when the weather permits to allow a complete change of air. In damp weather the humidity should be watched, and if it reaches 60 per cent fires should be started. In cold weather the temperature should not be allowed to drop below 45 deg.

This brief description of the method of handling sweet potatoes will indicate that there are three weather extremes to be considered in the design of a storage house: The first, exceptionally warm weather with high humidity during the curing period, which requires the maximum of ventilation capacity; second, cold weather during the curing period, which requires extra fuel capacity, careful regulation of draft, and good floor, wall and ceiling insulation; and third, the cold winter storage period, which requires good insulation of the building and airtight walls, doors and ventilator dampers to protect the potatoes during the coldest days.

The type of house in most common use is of frame construction with two layers of sheathing separated by building paper, on the inside of the studding, and the same repeated on the outside with the cracks battened, or with drop siding used in the outer layer. The floor and ceiling are also double sheathed with building paper between. Eight square feet of exhaust vent area in four flues and a corresponding intake area in eight floor openings are provided in each 16x32-ft. carload unit to meet the maximum ventilation requirement during warm wet weather. A stove with a ten or twelve-inch grate diameter is usually adequate in fuel capacity to meet the exceptional heat requirements on a four-hour firing basis.

With these factors of insulation, ventilation area and grate size fixed, we investigated the performance of six combinations of variable features of storage house designs as follows:

Test 1. Flat ceiling, heated intake, stove below floor, distributed heat, King type vents.

Test 2. Flat ceiling, heated intake, stove below floor, central heat, King type vents.

Test 3. Flat ceiling, part of intake heated, stove above floor, Rutherford type vents.

Test 4. Standard type check. Sloping ceiling, part of intake heated, stove above floor, Rutherford type vents.

Test 5. Sloping ceiling, part of intake heated, stove above floor, King type vents.

Test 6. A proposed improvement in design. Sloping ceiling, heated intake, stove below floor, distributed heat, Rutherford type vents.

Some of the results of these tests are shown on the accompanying graphs. These curves are only of use in comparing the performance of these tests as humidifying apparatus had to be used to simulate the presence of potatoes. The fuel economy is not given here because the variations in outside temperatures would make direct comparison impractical. It is well to mention, however, that the relative fuel economy in these tests is not in disagreement with any conclusions expressed herein.

The 1926 test was not considered at all in this paper. This was the first test of the house with sweet potatoes in storage. Due to conditions beyond the operator's control the filling period occupied nearly ten days, which was sufficient reason for discarding the data. The potatoes, however, were saved in good shape with the house arranged the same as in Test No. 6.

In 1927 the house was left as for Test No. 6, but with better insulation about the entire building including the foundation wall. The sweet potatoes were stored on November 20. In this test an attempt was made to operate just below 80 deg. F. The average outdoor temperature. 59.2 deg., was over 6 deg. cooler than in any of the six preliminary tests.

A few conclusions from the preliminary tests, supported by the graphs of results, are as follows:

1. Shortening of draft ducts to the minimum, thus reducing friction, gives most effective evaporation.

2. The admission of large amounts of unheated air is highly effective in causing evaporation.

3. The two conditions just mentioned are conducive to the highest fuel economy.

4. Sloping ceilings increasing the effective height above the top layer of crates and tending to streamline the exhaust currents to vents in the ridge are more conducive to uniform temperatures than a flat ceiling under the above conditions, but both give poor results in this respect.

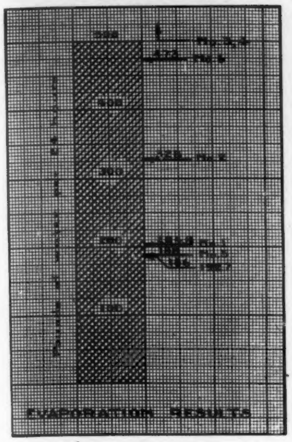
5. The most uniform temperatures are obtained with distributed heat; in these tests the distribution was made through a hot air-pipe system.

6. Uniformity of temperature characteristics are accompanied by uniform relative humidity.

The type house used in Test No. 6 was used to cure the 1927 sweet potato crop, and the curves indicate that the characteristics of the house are distinctly parallel in both tests although naturally in a different range of temperatures and relative humidity. The outdoor temperature difference between the two tests was 14.2 deg. F., while the indoor temperature difference was approximately 8 deg. Even this difference indoors is to be accounted for in part by the effort of the operators to use a temperature just below 80 deg. to study the effect on the potatoes.

There are other items of interest which may not be discussed here for lack of space. Some condensed tables are appended for the inspection of those interested in other measurements of the performance of these houses.

These tests have furnished data relative to design in



DATA SUMMARY TABLE
SHOWING AVERAGE PERFORMANCE RECORDS IN SEVEN TESTS

Test No.	Outside Temp. °F.	Outside Hum. percent	Inside Temperature above floor 2' ht	5' ht	8' ht.	Humidity above floor 2' ht	8' ht.	Moisture removed per lb. air	Velocity of air ft./min.	Fuel lb. per day
1	71.4	52.4	82.3	83.5	84.8	57.5	53.5	grains 37	56	
2	66.5	58.6	77	81.7	92	68.3	56.6	46	65.7	61
3	73	48	75.7	78.5	95.5	62.5	53	78	159	52
4	80.3	47	79.2	81.5	89.6	66.5	62.3	60	168	86
5	80.5	55.7	84.5	85.8	94.5	76.4	59.6	48	46.2	42
6	73.4	66.2	84.5	86.2	89.4	63.8	58	38	142	61
1927	59.2	56.7	75.2	78.8	80	35.4	34.5	12	137.2	

which we feel we can place some reliance but which must be tested further before being published. We have our plans laid for the operation of a type of house which we hope will combine high evaporative characteristics with good fuel economy and ease of control. With an approach to this condition of operation we will be in a position to correct our designing data. The dynamic forces in the natural draft system of ventilation are so slight that their effective utilization requires a nicety of balance in the various factors of house design, as may be noted in some data presented herewith. Hence, we believe it expedient if not essential to approximate a good ventilation performance before accepting the results of draft, fuel and other measurements as reliable for designing purposes. In other words, the interrelation of certain factors is such that reliable data cannot be obtained through isolated studies of these factors.

Torque Dynamometer for Tractor Drivewheels

By E. G. McKibben[1]

A THOROUGH study of any type of traction equipment necessitates a determination of its efficiency in the field under various conditions of soil, load, and speed. To do this it becomes necessary to measure the energy input to, as well as the energy output from, the tractive device being investigated.

A careful study of the dynamics of the conventional rear-drive, wheel-type tractor indicates that it is possible to determine the energy input to the drivewheels by measuring the supporting reaction[2] of the front axle against the tractor frame, and counting the revolutions of the drivewheels. The situation is simplified, if the tractor is assumed to be operating on level ground and to be designed so that the lines of action of the thrusts of the radius rods, which push the front wheels, pass through the center line of the rear axle. Unless otherwise stated these conditions are assumed in this article, because most test fields are approximately level and because the proper point of attachment of the radius rods can be readily taken care of when the dynamometer is being built into the tractor. However, if it becomes desirable or necessary to make tests on a grade, the proper connections can be made by the application of simple trigonometric methods.

Analysis. (Note Fig. 1.) Considering the frame of the tractor as a free body, the only important external forces acting on it and whose lines of action do not pass through the center line, c, of the rear axle, are the force of gravity due to weight W, the front axle supporting reaction[2], F, the drawbar pull, P, and the rear axle driving torque, T.

Taking moments about the center line of the rear axle, C, gives the following moment equations for the situation shown in Fig. 1:

$$T + Fb - Wa - Pd = 0 \qquad (1)$$

Solving for T

$$T = Wa + Pd - Fb \qquad (2)$$

For a given tractor under given operating conditions a, b, d and W are constant and can be readily measured by conventional methods. P can be measured by any standard type of traction dynamometer. This leaves F, the supporting reaction[2] of the front axle, as the only unknown of Equation 2. Therefore, the problem is only that of designing and

[1]Assistant professor of agricultural engineering, University of California. Mem. A.S.A.E.

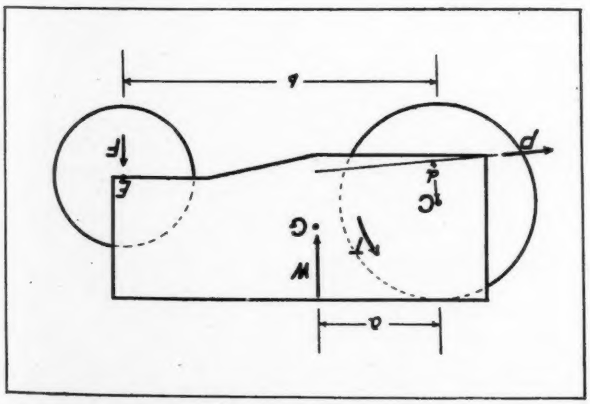


Fig. 1. Diagramatic sketch of the external forces acting on the frame of a tractor

[2]That force which must be supplied by the front axle in order to support the effective weight of the front end of the tractor frame.

Notation for Fig. 1

a, perpendicular distance from C to line of action of W. (Since the line of action of W is vertical, a will be horizontal)
b, perpendicular distance from C to line of action of F
d, perpendicular distance from C to line of action of P
c, center line of rear axle
E, center line of front axle
F, supporting reaction of front axle (that force which must be supplied by the front axle in order to support the effective weight of the front of the tractor frame)
G, center of gravity
P, drawbar pull
W, weight of tractor.

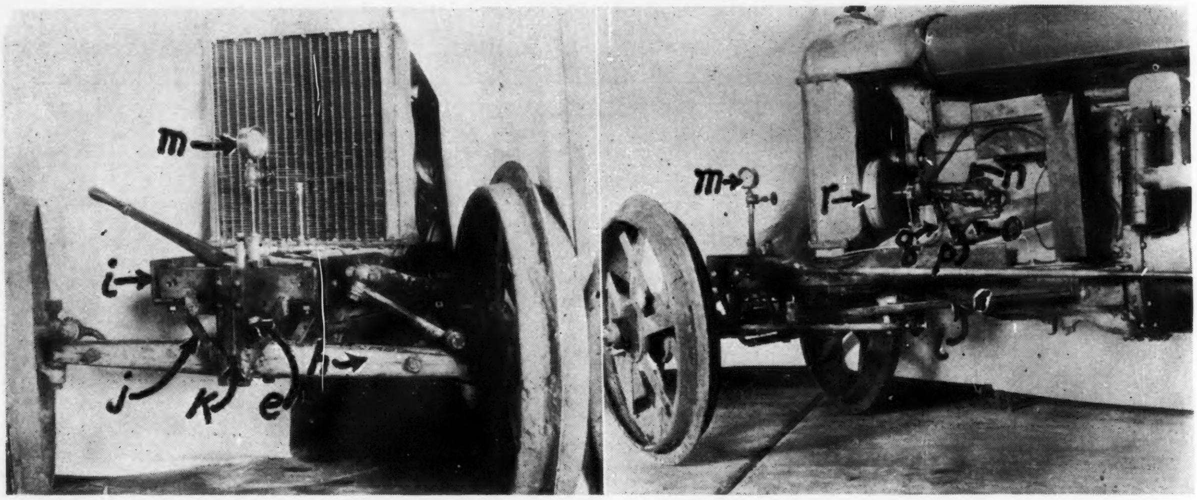


Fig. 3 (Left) and Fig. 4 (right). Two views showing details of the hydraulic dynamometer for measuring the supporting reaction of the front axle

building a satisfactory instrument for measuring the supporting reaction of the front axle.

Hydraulic Dynamometer. The hydraulic dynamometer shown in Figs. 2 to 4 is one solution of this problem of measuring the supporting reaction of the front axle. There are undoubtedly many other possible and probably equally satisfactory solutions.

This dynamometer of which Fig. 2 is a diagramatic sketch consists of a piston, e, (Figs. 2 and 3), and a cylinder, f, (Fig. 2) with a by-pass, g, (Fig. 2) between the front axle, h, (Figs. 2 and 3) and the tractor frame, i, (Figs. 2 and 3); a crosshead, j, (Fig. 2) to guide the front axle pivot pin, k, (Fig. 2); a radius rod, l, (Fig. 4) so attached that the line of action of its thrust passes through the center line, C, (Fig. 1) of the rear axle; a calibrated pressure gauge, m, (Figs. 2 to 4); a large truck engine gear type oil pump, n, (Fig. 4) with suction pipe, o, (Fig. 4), discharge pipe, p, (Fig. 4), stuffing box leakage return pipe, q, (Fig. 4), and pulley, r, (Fig. 4) for driving the pump from the fan belt.

Advantages. Any method of measuring the rear axle torque by using a dynamometer between the front axle and the frame has the following advantages over direct dynamometers between the rear axles and the drivewheels:

1. Only one measuring device is needed.
2. No rotating parts are necessary.
3. It is not necessary to disturb the measuring device in any way when changing either the drivewheels or drivewheel equipment.

Disadvantages. Compared with direct dynamometer between the rear axles and the drivewheels this method has the following disadvantages:

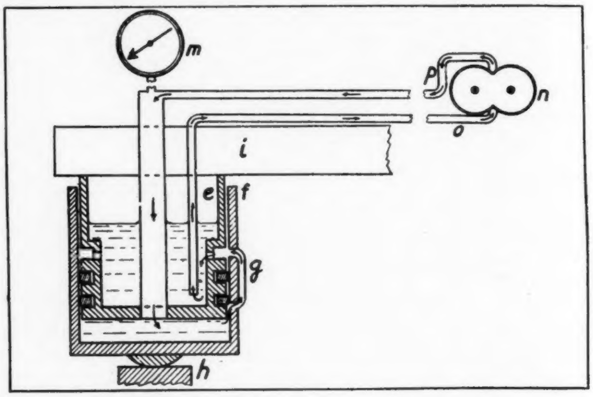


Fig. 2. Diagramatic sketch of hydraulic dynamometer

1. Its efficient use under certain conditions requires a better knowledge of elementary mechanics.
2. Under very rough, uneven soil surface conditions, provision must be made for damping the resulting vertical acceleration forces.

In spite of these disadvantages, it appears that this method of measuring the power input to traction equipment under actual field conditions offers some very worth while and interesting research possibilities.

A Case of Spontaneous Ignition in Stable Manure

DEPARTMENT of Agriculture specialists have reported an observed case of spontaneous ignition in stable manure at the Arlington Experiment Farm at Rosslyn, Virginia. Manure for fertilizer purposes had been hauled from a nearby cavalry station and placed on the farm grounds in an open plot. As the manure was unloaded the horses and wagons were driven over the pile and the load of manure was deposited on top. The custom had been to "cure" the manure from one to three years before spreading. The first loads had been deposited some two and a half years before and the mass had grown to a pile about 200 feet long, 40 feet wide, and from 1 to 20 feet high. Moderate heating of the manure had been accepted as an essential part of the curing although fire had not formerly occurred.

Before September 9, 1925, the date of the fire, the weather had been warm, ranging from 87 to 95 deg. F. There had been no heavy rains for at least two weeks. Daily additions had been made to the pile, and although the mass was known to be excessively hot, the condition was not considered dangerous. Fire broke out during the night of September 9 and was discovered by the night watchman. The flames quickly spread over the entire west side of the pile. Water was applied from pails and the flames were extinguished. Within a few hours, however, fire again broke out along the same side of the mass.

The following afternoon, September 10, fire broke out on the opposite or east side of the pile. When this fire had been put out, an inspection of the stack revealed so many hot areas along the edges that the entire side was removed under frequent sprinkling with water.

This very definite observation, as well as many others of a similar type, indicate the possibility of spontaneous ignition of manure piles which may in some instances be closely related to unexplained barn fires.—David J. Price.

Tests of Tractor Wheel Equipment[1]

By H. B. Josephson[2]

THE advent of the general-purpose tractor is bringing new demands upon tractor wheel equipment. No one wheel has yet been found that meets the requirements of all operations performed by this versatile machine. In plowing, good traction is the most important consideration; in surface tillage, minimum packing is required in most soils; in hauling and other jobs where the tractor runs on hard ground at a fairly high rate of speed, ease of riding is essential. Further complication is brought about by the fact that in cultivating row crops various widths of rows are used and some plants, as potatoes, spread out until the wheel has a limited space in which to travel. An analysis shows many of these requirements to be conflicting. A wheel that gives good traction is usually too rough riding to be used on the road and may be too wide for the cultivation of certain crops. A wheel that rides smoothly on the road will often pack the ground excessively and is likely to fail to provide sufficient traction for heavy field work.

Certain tests and observations have been made at the Pennsylvania Agricultural Experiment Station on the wheel equipment supplied for one tractor of the general-purpose type. During the past two years this tractor has been used in power and labor studies[3]. All tests and observations were made on Hagerstown clay soil. Large rocks which are prevalent in this soil present additional difficulty to traction as the wheels will frequently slip on a rock under a heavy load, placing a great strain on the lugs.

Wheel Equipment Used. A photograph of the wheel equipment used is shown in Fig. 1. Wheel A was originally supplied with the tractor. The angle lugs have proven satisfactory for most heavy work from the standpoint of traction. However, the angles were not stiff enough to resist occasional slippage on flat rocks which caused them to bend. After one season's work they had to be straightened to restore traction. This wheel is very rough riding on hard ground. Wheel B consists of an 11-in. rim, with spade lugs, built in two semi-circular sections and bolted to an open rim (same as Wheel C with the cone lugs removed). The rim is very conveniently removed, leaving the smooth wheel for light hauling on the road. The cross braces furnish a certain amount of traction if the ground surface is not too smooth. Used in this way the tractor rides smoothly but traction is limited. Wheel C is the same as Wheel B with cone lugs substituted for the solid rim and angle lugs. When used for field work the open wheel has a tendency to ball up if the ground is slightly wet. At times when the soil was sticky, small rocks were carried around with the wheel and wedged between the spokes and the brake drum. Under favorable conditions this wheel equipment was found satisfactory for general field work but did not ride any smoother than Wheel A. Wheel D is a specially constructed wheel with dished spokes to bring the wheels closer together in order to meet the usual width of potato rows. It has a 6-in. face, the same as Wheel A. The cone lugs are well suited for cultivating, where space between rows is limited, but are not suitable for heavy work.

There is not much choice in riding quality between the various types of metal wheels with lugs. None of them are satisfactory for hauling on ordinary farm roads. It was in an attempt to secure a wheel suitable for hauling as well as for general field work that the rubber-tired wheel was introduced (See "E" Fig. 1). This set of wheels was specially built for this tractor for use in this experiment.

Rubber Tires for the General-Purpose Tractor. The rubber tires were used without chains for harrowing, pulverizing, disking, planting corn and potatoes, drilling grain, cultivating, loading hay, hauling on the road and cutting grain. Sufficient traction was obtained for all these jobs when the ground was dry on top. In harrowing it was necessary to attach chains at one time after a local shower. It took very little moisture on the surface to cause the wheels to spin. The loads did not exceed 750 lb. drawbar pull.

Plowing with the rubber tired wheels was attempted on three occasions, but the moist furrow sole always caused excessive slip even when chains were used. The chain equipment consisted of eight cross chains on each wheel. One of these is shown in Fig. 1. At one time a round was made just after the noon hour when the sole of the furrow was dry. The wheels were equipped with chains. No difficulty was experienced due to slippage. On the second round, however, the wheels spun almost immediately in the freshly plowed furrow. The wheels had to be changed and the plowing was continued using the open wheels with cone lugs.

Some of the work was done with rubber tires in front as well as in the rear. Steering was made more difficult and there seemed to be little need for the use of rubber-tired front wheels for purposes of securing smooth riding. Even on a hard farm road the metal front wheels do not cause much jarring of the tractor. With metal front wheels and rubber-tired drivewheels the tractor was driven in high gear (4 mi. per hr.) over rocky farm roads with perfect comfort to the operator. On these same roads the tractor was shaken excessively in low gear (2 mi. per hr.) with metal wheels and lugs. When chains were used on the rubber tires, there was little gained in riding quality over the metal wheels.

Packing Effect of Different Wheels. The clay soil on

[1]Fourth of a series of six articles based on the results of a power and labor research study at the Pennsylvania State College. Released for first publication in AGRICULTURAL ENGINEERING as technical paper No. 457 of the Pennsylvania State College, School of Agriculture and Experiment Station.

[2]Agricultural engineer in charge of farm machinery research, Pennsylvania State College and Agricultural Experiment Station. Mem. A.S.A.E.

[3]AGRICULTURAL ENGINEERING, Vol. 9, No. 7 (July, 1928).

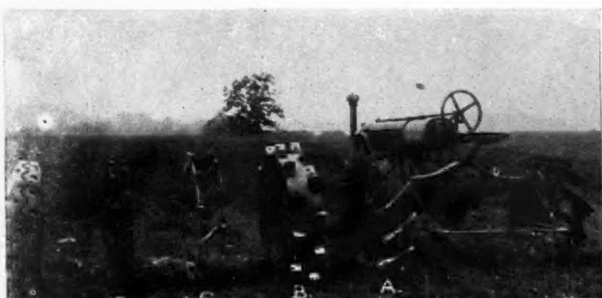


Fig. 1. (Left) Wheel equipment used. A, angle lugs on 6-in. rim. B, spade lugs on 11-in. rim. C, open wheel used with or without cone lugs. D, narrow tread wheel with 6-in. rim equipped with cone lugs. E, rubber tired wheels used with or without chains. Fig. 2. (Right) Dynamometer car used for loading tractor. Various loads were applied at increments up to the maximum capacity of the wheel and the distance traveled in five revolutions of the wheel measured. The distance traveled at no load was used as a basis from which to calculate slip

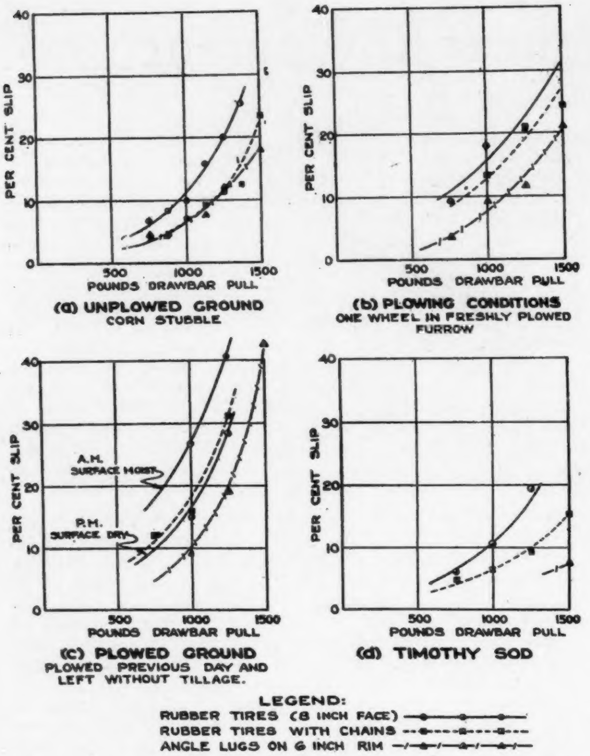


Fig. 3. Relation between slip and drawbar pull with rubber-tired wheels and angle lugs in clay soil

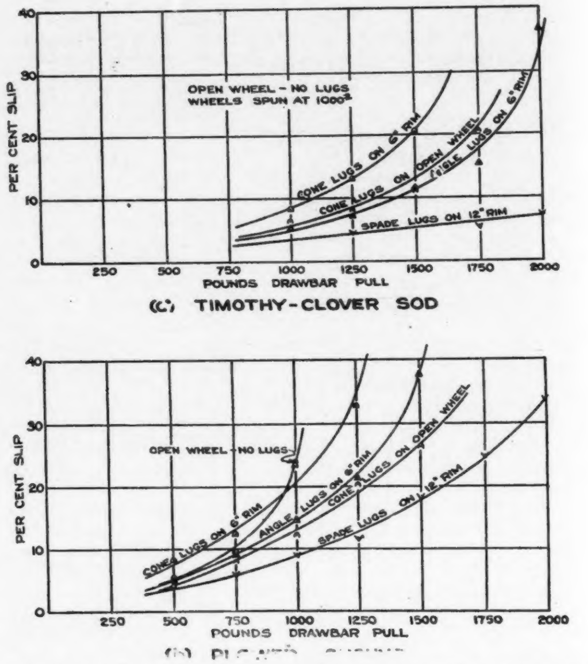


Fig. 4. Relation between slip and drawbar pull with various metal wheels in clay soil

which these tests were made is subject to excessive packing when wet. At certain times the tractor must be used when the soil is too wet for best results, therefore packing is an important consideration. Although attempts at measuring this packing effect have not yielded consistent results the indication is that the rubber-tired wheel packs the soil considerably more than any of the metal wheels used in this work. This seems to be a very serious drawback to the use of rubber-tired wheels.

Slippage Tests. Traction is one of the most important requirements of a tractor wheel and at the same time lends itself most readily to actual physical measurement. Slippage tests were made on the various wheels shown in Fig. 1. It was desired to obtain the relation between slippage and load. An attempt was made to duplicate as nearly as possible actual field conditions. The tractor was loaded with an Iowa horse testing dynamometer which makes it possible to apply a predetermined load that will not vary throughout a given test[4]. Fig. 2 shows the dynamometer hitched to the tractor. The load could be varied at will except that there was some difficulty in securing a small enough load, the minimum load being determined by the force required to pull the car without applying the braking effect used to furnish the load. However, small loads, below 500 lb., were of little value except for purposes of obtaining continuous slippage curves from no load to maximum capacity. The tractor was first driven with no drawbar load and the distance traveled in five revolutions of one drivewheel measured. It was then hitched to the dynamometer under load and the distance traveled in five revolutions again measured. The load was increased by increments usually to a point where the wheels spun. The distance traveled at no load was used as a basis from which to calculate slip. All runs were made in low gear (2 mi. per hr.) with throttle wide open so that nearly the same speed was maintained.

As the various wheels differ somewhat in diameter as well as in other details the dimensions are given in Table I.

Traction Obtained With Rubber Tires. Fig. 3 shows the relation between slip and drawbar pull using rubber-tired wheels and angle lugs on clay soil under various conditions.

On unplowed ground, which had been in corn the previous year, the rubber-tired wheels without chains slipped a great deal more than did the 6-in. wheel with angle lugs. At 1000 lb. the slip was about 10 per cent while beyond that load it soon became excessive. The soil was very firm and contained considerable moisture. It would have been in excellent condition for plowing. The surface was hardly dry after a recent rain. With chains the slippage of the rubber-tired wheels was reduced to very nearly that of angle lugs (See Fig. 3a.).

When the tractor was operated to simulate actual plowing conditions, with one wheel running in a freshly plowed furrow, chains reduced the slippage only slightly. The angle lugs showed a much lower slip than the rubber tired wheels with or without chains. (See Fig. 3b.) The slip was measured on the wheel running in the furrow.

On ground plowed the previous day and left without surface tillage, the rubber-tired wheels showed a much higher slip than the angle lugs, and when the surface was dry somewhat less slippage occurred without the use of chains. However, when the surface was moist the slip without chains was excessive. The difference in slip due to the condition of the surface in the forenoon and afternoon of the same day is shown clearly in Fig. 3c. This difference did not hold when chains were used.

On timothy sod the rubber-tired wheels without chains show very nearly the same slip as on unplowed ground. Chains improved the traction considerably, but it was still much higher than in the case of the angle lugs. (See Fig. 3d.).

Traction Obtained With Various Metal Wheels. Slippage tests were made on the various metal wheels on sod and on

TABLE I

Wheel	Type of wheel equipment	Diameter of rim	Width of face	Height of lug	Wheel tread
A	Angle lugs on 6-in. rim	40 in.	6 in.*	3¼ in.	74 in.
B	Spade lugs on 11-in. rim	42½ in.	11 in.	4 in.	76 in.
C	Open wheel with cone lugs	42 in.	8½ in.	2¾ in.	76 in.
D	Cone lugs on 6-in. rim	40 in.	6 in.	1¾ in.	69 in.
E	Rubber tires	40 in.	8 in.		80 in.

*Width of angles measured straight across wheel face—12 in.

[4]For the principle of operation of this dynamometer see AGRICULTURAL ENGINEERING, Vol. 4, No. 8 (August, 1923).

plowed ground. The results are given in Fig. 4. On timothy-clover sod by far the least slippage occurred with the spade lugs on a solid 11-in. tire (See Fig. 4a.) At 2000 lb. drawbar pull the slip was only 7.4 per cent. No loads were taken above that point. The angle lugs on a 6-in. tire showed about twice as much slip as the spade lugs. The open wheel with cone lugs showed slightly more slip than the angle lugs, but without lugs the open wheel spun at a load of 1000 lb., indicating very poor traction. The cone lugs on a 6-in. rim showed a high slip as compared with the other wheels with lugs. The ground was dry when these tests were made.

Fig. 4b gives the results of tests made on plowed ground with the various metal wheels. The land, which was timothy-clover sod was plowed 8 in. deep three days before the tests were made and left without surface tillage. The ground was dry when plowed, but a heavy rain that fell soon after the plowing was done left the soil moist to the depth of the furrow slice but it was still very loose when the tests were made.

The spade lugs again show by far the least slip. The angle lugs with 6-in. rim slipped slightly more than the open wheel with cone lugs while the cone lugs on the 6-in. rim show an excessive slip at all loads. The open wheel with no lugs shows a comparatively low slip up to a load of 750 lb. (only slightly higher than that of the same wheel with cone lugs). After that point the slip increased very rapidly.

SUMMARY

1. Rubber-tired wheels without chains provided sufficient traction for general field work, other than plowing, only under the most favorable conditions. A little moisture on the surface caused the wheels to spin.

2. The tractor equipped with rubber-tired drivewheels and metal front wheels was driven at 4 mi. per hr. over rocky farm roads with perfect comfort to the operator.

3. Rubber-tired front wheels made steering difficult and were not necessary for purposes of securing easy riding.

4. The ground appeared to be packed more by rubber-tired wheels than by any metal wheels used.

5. Spade lugs on an 11-in. rim gave by far the best traction of all wheels tested both on plowed ground and in sod.

6. Angle lugs on a 6-in. rim gave very nearly the same traction as the open wheel with cone lugs.

7. The open wheel without lugs worked well for light hauling; the tractor rode smoothly but traction was limited. The solid rims with angle lugs were conveniently attached to this wheel for field work.

Strength Tests of Soldered and Riveted Joints

By J. Grant Dent[1]

A FEW years ago tests were started in the agricultural engineering division of the University of Minnesota to determine the tensile strength of various soldered and riveted lap joints. When looking up what had been done along this line of investigation, one thing stood out with the most prominence, namely, that most writers disagree. The following quotations were taken from various books and bulletins:

"A good formula for the composition of soft solder is: Lead, 207 parts; tin 118 parts. To weaken the solder increase the number of parts of tin. Increasing the number of parts of lead will strengthen the solder." The above formula would be about 36 + per cent tin and 63 + per cent lead.

Another writer says: "The solder generally used is composed of half tin and half lead, commonly called half-and-half. A better flowing solder, one having more resistance to stress, is composed of 60 per cent tin and 40 per cent lead. The latter is the very best combination."

Another writer gives the following solder formula:

"Common solder—1 part tin, 1 part lead
Fine solder—2 parts tin, 1 part lead
Cheap solder—1 part tin, 2 parts lead."

One book contained the following statement: "Soldered seams have no strength in themselves and are likely to fail if stressed to any appreciable degree."

Only one writer referred to actual tests: "In a series of tests a notable point brought out was the varying degrees of strength with age. Tensile strength increases with the per cent of tin present, but when solder age is considered its maximum value is reached at 60 per cent of tin. For general work the solder requiring resistance to stress is 60-40, but for work with little or no strain, less tin may be used."

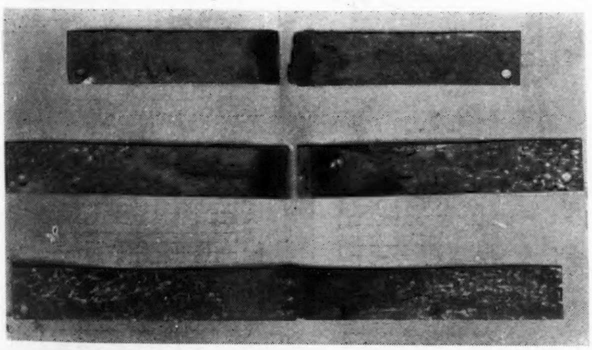


Fig. 9. (Top) Showing soldered surfaces of Test No. 5 of Curve A, Fig. 5. Black portion shows opposite steel where galvanizing pulled off. (Middle) Soldered surfaces of Test No. 9 of Curve B. Fig. 5. Galvanizing was removed before soldering. (Bottom) Test No. 8 of Curve A, Fig. 6, after testing. No attempt at neatness was made in these tests

The U. S. Navy specifications for solder are: "Equal parts of tin and lead."

The hardest mixture of tin and lead according to one writer is 64-36.

The melting point of solder as given by one writer is as follows: "The melting point of the tin-lead alloys decreases almost proportionally to the increase of tin, from 619 deg. F., the melting point of pure lead, to 356 deg. F. when the alloy contains 68 per cent of tin, and then increases to 448 deg. F., the melting point of pure tin."

Tin plate was used in the first series of tensile strength tests. Fig. 1 shows the average strength of 30 tests, each of different mixtures of tin and lead. Ten tests of each were made in 1926, ten in 1927, and ten in 1928. The metals were weighed and mixed in the mechanical training laboratory and were three different lots of metals.

The tin used in each set of tests was in bar form. The lead used was sheet, pig and large shot. The sheet metal soldered together was IXXX tin plate 2 in. wide, lapped ⅛ in. It is interesting to note that the 50-50 homemade solder did not equal the strength of the commercial solder used in all tests shown in the graphs, except "E," Fig. 2. This is probably due to the mixing in small amounts.

In making these solders, the metals were first weighed, then melted separately and mixed thoroughly. The molten metals were kept covered with resin to prevent oxidation as much as possible.

The edges of the tin plate to be lapped were cleaned with emery cloth until practically all traces of tin were removed for ¼ in. from the edge. This was done to prevent the tin from mixing with the solder and changing the mixture of tin and lead.

Fig. 2 shows results of tests to determine the difference in strength when the metals are pressed together when soldered and when held apart with wires, also when pressed together and lapped ¼ and ½ in. It is interesting to compare curves A and E. A was a solder bearing the maker's trademark and E was without any identification whatsoever. All specimens were 2 in. wide, and were cut crosswise of the sheet (See Fig. 3). Each curve represents ten tests.

Fig. 3 shows the difference in tensile strength when speci-

[1]Instructor in agricultural engineering, University of Minnesota. Mem. A.S.A.E.

mens were cut crosswise and lengthwise of the sheet. The tenth test piece in curve B was cut from the edge of the sheet. The sheets were 20x28 in. and measured approximately 0.002 in. more in thickness at the center than at the edge. The difference in tensile strength is apparently due to the method of manufacture as explained in the following quotations:

Oberg and Jones, in the book "Iron and Steel," say: "Sheet bars are 6 to 12 in. wide and not over 2 in. thick."

Danforth, in "Mechanical Processes," says: "At the steel mill, 30-ft. sheet bars are cut into short lengths, heated in a reheating furnace and run through the rolls sidewise, as the width of the bars is stretched out to form the length of the sheet. Rolling stretches the metal in the direction of its travel through the rolls and very little if any in the direction of the axis of the rolls, hence bars are cut into lengths but slightly longer than the width of the sheets to be rolled from them."

The reason for the greater tensile strength when specimens are cut crosswise of the sheet seems to be that the original lengthwise grain of the sheet bar runs crosswise of the sheet. Another interesting thing is that when this original grain is subjected to right-angle bends (see Fig. 7, B and D), it will stand only a little over half as much as when the bend runs the opposite way.

Fig. 4 shows the tensile strength of 22-gage galvanized steel. Not as great a difference is shown here as in A and B of Fig. 3, although in Fig. 7 the right-angle bends show about the same as tin plate. Fig. 4 also shows a comparison of galvanized steel soldered joints lapped ½ in., tinned (coated with solder) before being soldered and not tinned. As no particular advantage was noted from first tinning the metals, all tests were made without tinning. There was no difficulty or loss in time in sweating the solder through the ½-in. seam from the edge. The zinc coating was not removed on these specimens.

Fig. 5 should be compared with Fig. 4. D of Fig. 4 shows galvanizing not removed and pieces held together while A in Fig. 5 shows pieces held apart approximately 3/64 in. with short pieces of tinned wires running lengthwise of the specimen.

These tests were made because of several nearly fatal accidents caused by hand-spraying outfits exploding. The lower end of the sprayer, where the failure took place, was made by pushing the end up inside the can, putting a bead about ½-in. deep in the can below the end and sweat soldering the end from the outside. The end was made cup shape and both can and end made of galvanized steel. In one case a farmer filled the sprayer, took it into the barn to spray the cows and gave the pump a couple of strokes, when the lower end of the can blew out throwing the whole outfit up striking him under the chin, knocking out several teeth and breaking his jaw. He was unconscious several hours. Upon examining this sprayer the failure appeared to be caused by the can being out of round and the end being a loose fit. On one side solder had been sweated in to a thickness of about 3/64 in. and the solder had pulled the zinc coating off for some distance. With this side loosened the end buckled and was forced past the bead in the can. The manufacturers of this particular sprayer are now using rivets as well as solder.

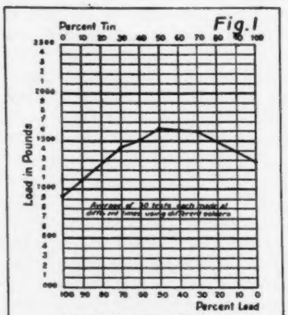
In Fig. 5 (A) the solder spread out for a considerable distance over the metal when filling in the gap between the metals, and in test Nos. 3, 4, 5 and 8 the solder broke part way and the zinc coating pulled loose over the rest of the surface as far as the solder spread. Test No. 7 pulled the zinc coating loose over the whole area covered by the solder. This appeared to be the case in the exploded sprayer.

The greater strength shown in the specimens held apart 3/64 in. is due to the solder spreading over about twice the area in the lap and of considerable thickness, although the strength is governed almost entirely by how well the zinc coating adheres to the steel as shown in test No. 7.

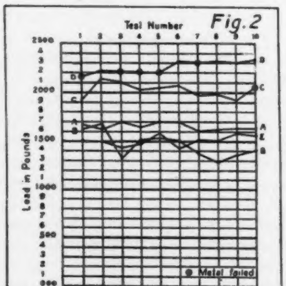
B of Fig. 5 should be also compared with D of Fig. 4, showing that with the zinc coating removed the specimen tested approximately 7 per cent stronger. However, removing the zinc coating thoroughly is a difficult task and very seldom practical, especially in commercial work or manufacturing. These specimens were first cleaned with emery cloth, then repeatedly washed with raw hydrochloric acid until all traces of zinc disappeared as far as the solder would cast the metal.

Fig. 6 shows the joint riveted as well as soldered. Curve A is the strength of solder and rivets on specimens where all traces of the zinc coating had been removed, and B is the load the rivets held after the solder had failed. C shows the same kind of a joint except the zinc coating was not removed. Curve D is the load held by the rivets after the solder failed. E represents rivets only.

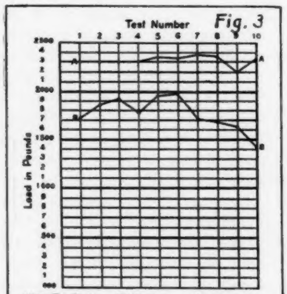
Results of these tests seem to show that the safest joint



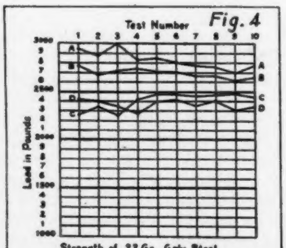
Various Mixtures of Tin & Lead
IXXX Tin Plate Lap ½ in.



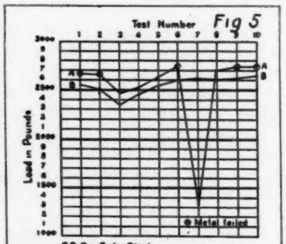
IXXX Tin Plate Average Load.
A Held close together Lap ½ in. 1655 lbs.
B Pieces held apart 3/64 in. Lap ½ in. 1485 "
C Lap ¾ in. 2030 "
D Lap ½ in. 2260 "
E Solder without Trademark Lap ½ in. 1515 "



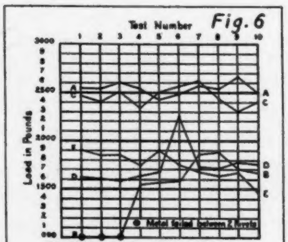
IXXX Tin Plate Width 2 in. Average Load
A Cut crosswise of sheet 2315 lbs.
B Cut lengthwise of sheet 1770 "



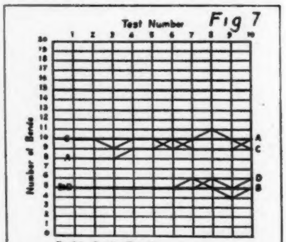
Strength of 22 Ga. Galv. Steel
Width 2 in Average Load
A Cut crosswise of sheet 2840 lbs.
B Cut lengthwise of sheet 2700
Soldered Joint Lap ½ in
Cleaned with emery cloth only Average Load
C Tinned first 2415 lbs
D Not tinned 2375 "



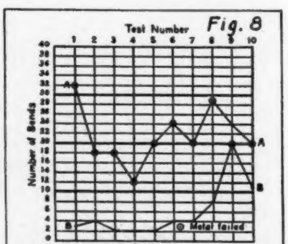
22 Ga. Galv. Steel
Width 2 in. Lap ½ in Average Load
A Galv. not removed Pieces held apart 3/64 in. 2525 lbs.
B Galv. removed Pieces held together 2555 "



22 Ga. Galv. Steel 3 Rivets (*1½ Tinners)
Width 2 in. Lap ½ in. Average Load
A Galv. removed Solder & Rivets 2540 lbs.
B " " Rivets only 1425 "
C Galv. not removed Solder & Rivets 2455 "
D " " " Rivets only 1720 "
E 3 Rivets not soldered 1780 "



Right Angle Bends
A 22 Ga. Galv. Steel Bent crosswise of sheet
B " " " " " lengthwise " "
C IXXX Tin Plate " crosswise " "
D " " " " lengthwise " "



Soldered Joints broken by right angle bends
22 Ga. Galv. Steel Lap ½ in
A Galv removed Average 21.7 Bends
B Galv not removed 6.

in galvanized steel is shown at C. It would appear that the safe load should be based on the solder with the reserve strength of the rivets as an extra factor of safety, or on the strength on the riveted joint with the solder as an extra factor of safety and for making a tight joint. The holes for riveting were all drilled and this method is generally conceded to be better than punching because it does not tear or strain the metal.

Fig. 7 shows a series of tests when the sheet metals were bent. The specimens were held in a machinist's vise and bent to a right angle by hand, then back the opposite direction, etc.

It is interesting to note here that the original grain of the sheet bar, which runs crosswise of the sheet, will stand the least number of bends as shown at B and D. In A and C "bent crosswise of sheet" means the line of bend runs crosswise breaking the lengthwise grain of the sheet.

In all the soldered-joint tests the soldering copper was kept at a heat where the colors would run while in the fire. Zinc chloride diluted ¼ by volume with water was used for flux.

Fig. 8 shows ⅛-in. lap galvanized steel soldered joints subjected to right-angle bend. Probably the reason for the erratic curve A is that the specimens were 2x2-in. pieces with no attention being paid to the grain of the metal.

These tests were made on a Riehle 50,000-lb. testing machine.

SUMMARY

The results of these tests seem to bring out the following facts and suggestions:

1. Use a standard half-and-half solder bearing the trade mark of the manufacturer.
2. Press metals closely together for lap seams.
3. A ⅛-in. lap will practically equal the strength of IX tin plate.
4. A ¼-in. lap will very nearly equal the strength of IXXX tin plate.
5. A ½-in. lap will give approximately 90 per cent of the strength of 22-gage galvanized steel.
6. A soldered lap joint if subjected to severe strains should be riveted, then soldered.

Problem Factors in the Distribution of Some Nitrate Fertilizers

By D. B. Lucas[1]

EVERY agricultural engineer enthusiastically welcomes new developments in crops and products which increase their adaptability for machine handling. When the use of the combine harvester was threatened because of shattering the oats, the situation was considerably lightened by the development of an oat variety which would withstand the agitation of the machine. The problem of harvesting sorghum in California was greatly simplified by selective breeding for uniformity of height of the plant head. Among the problems which have long perplexed machinery designers has been the accurate distribution and placing of commercial fertilizers. Lack of uniformity, dampness, stickiness and corrosive tendencies of many fertilizers have baffled the efforts of engineers in producing an accurate, practical, economical distributor. A new step in the manufacture of fertilizers now gives promise of throwing more light on the problem. Much as the engineer delights in the successful negotiation of age-old difficulties in farming processes by the adaptation of machinery, he is, nevertheless, eager to greet any step which helps adapt the product or crop to mechanical methods.

By means of purification of sodium nitrate fertilizer and improved manufacturing processes at least one company is developing a granulated product which may help solve some of the problems connected with distribution. Samples of this new fertilizer disclose unusual uniformity of grain size, remain dry enough for use under damp atmospheric conditions and are to a large extent free from sticky qualities. It may be recalled at this point that some of the factors which contribute to the high accuracy with which corn can be planted are as follows: Size, uniformity of size, hardness, dryness, smoothness, low adhesive tendency and weight. The new nitrate has many of the external qualities of dry grain and may be made in almost any practical grain size suitable for use. The size is probably as uniform as could be desired. The hardness, dryness, smoothness and freedom from stickiness all seem to exceed the common nitrates used heretofore. This new nitrate product appears to be an improvement on former products in every quality concerned with accurate distribution. The purity of the product is a further advantage in its satisfactory use. The comparative ease with which the distributor may be freed from residues after using should prove a safeguard to the extreme corrosion so commonly experienced.

In order to test out the new nitrate with the present distributing equipment the New Jersey Agricultural Experiment Station calibrated several representative distributors. The results of these tests are given in the accompanying table. The overrun for each of the nitrates is given in percentages and is also indicated by the comparative pounds per acre for each setting. The trade names of the various nitrates have been omitted for obvious reasons.

The International grain drill has the finger feed or star fertilizer distributor attachment. This is the most common type of forced feed and needs little explanation. The feeding device has a variable gate opening for regulating the rate. While the measuring out of the fertilizer is always positive in this machine it is obvious that opening the gate tends to decrease the accuracy. This is because the only fertilizer which is positively carried is that between the fingers. Opening the gate merely allows more fertilizer to ride on top of the feeder and there is nothing in the construction to prevent this additional material from being held back or from pouring out constantly through the opening. The factory calibration of the distributor is based on quantity of fertilizer, but for the convenience of the farmer it has been converted to weight on the basis of 2 lb. per quart. Any fertilizer which varies from 2 lb. per quart in weight will be distributed with corresponding inaccuracy.

The Aspinwall potato planter and Black Hawk corn planter attachments place fertilizer in the rows at planting time. Both devices are of special forced feed types and control the rate of distribution by a variable opening. Although differing in appearance from the finger feed just mentioned, each of these distributors is capable of about the same quality of work.

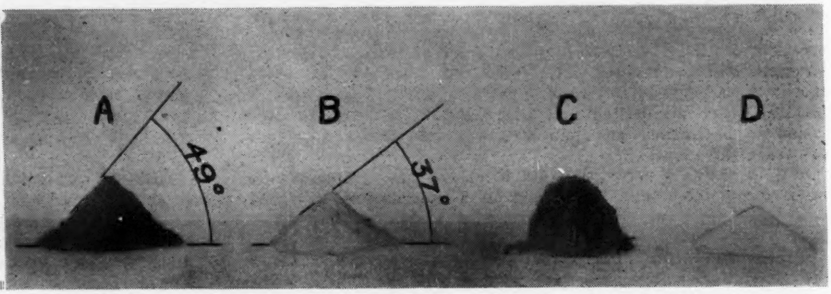
The Pommerania distributor is made in Germany. Strictly speaking it may be called a forced feed machine but gravity plays an important part in carrying out the fertilizer. This will be apparent in studying the results of the test.

A common sodium nitrate having the texture of a coarse grade of salt (NaCl) was used to compare with the new product. All of the nitrate had been exposed to the atmosphere for several days and had absorbed considerable moisture. The tests were made in hot, damp weather. Only a small quantity of the new fertilizer was on hand and this necessitated several limitations in the tests. A minimum of handling was desirable in order to keep the material clean and cut down losses as well as to prevent excessive grinding and breaking up of the fertilizer in the hopper. For that reason all tests were made wth the machine mounted stationary and duplicate runs were omitted. However, the tests which have been run bring out certain points which were of immediate concern.

An examination of the tabulated results will be facilitated by a brief consideration of the method of tabulation and computation. The first column indicates the setting of the machine followed by the corresponding rate of delivery listed by the manufacturers. This rate is based on a weight of 2 lbs. per quart. The third column indicates the fraction of an acre supposedly covered by the test. The fourth column

[1]Assistant professor of agricultural engineering, Rutgers University. Assoc. Mem. A.S.A.E.

The photograph shows the results of two of the tests used to bring out the physical qualities of the fertilizers. A and C are samples of the common sodium nitrate. B and D are the new nitrate. A and B show the angles of repose for the two fertilizers. The bases of these two piles are about equal in size. Samples C and D were both pressed into shape by hand. C retained its form while D immediately slumped to the flattened position shown



shows the pounds of fertilizer which should be delivered for the fraction of an acre indicated in the preceding column. Under the general heading of Common $NaNO_3$ are three columns. The first shows the weight of fertilizer actually distributed. However, since this material weighs 2 lb. 5 oz. per quart an adjustment was made in the next column to correspond to a weight of 2 lb. per quart. The per cent of overrun follows in the next column and indicates the inaccuracy of the distributor. The same computations were made for the new sodium nitrate. An additional column shows the pounds of the new nitrate per acre which the machine would actually distribute at each setting. A comparison between this column and the second column on the sheet shows at a glance the performance of the machine with the new nitrate.

A nitrate of very fine texture was also tried in the grain drill. This material resembles table salt or is perhaps even finer. It soon became so sticky upon exposure as to fail to pass through the finger feed and the testing of this nitrate was abandoned.

The results show a consistent overrun for the common and the new nitrates in the grain drill. This was true even though a correction was made for the high density of both fertilizers, each weighing about the same. The small fractions of an acre tested are accounted for by the lack of a large quantity of the new nitrate.

A short discussion of the physical qualities of the nitrates will help to explain many of the facts brought out in the tests. The behavior of each material in the distributor was believed to be dependent, perhaps largely so, on the slope required to make it roll due to gravity. This will be referred to as the angle of repose. It was found by tests that the common nitrate and also the extremely fine nitrate had an angle of repose of 49 deg. to the horizontal. In contrast the new nitrate would only stand at an angle of 37 deg. This compares well with some of the common seeds such as wheat and alfalfa with an angle of repose of 31 deg. All of these figures are approximate but they clearly indicate a difference in the physical properties of the fertilizers. Another test involved pressing a handful of fertilizer tightly and then allowing it to stand by itself. The common nitrate would remain standing even with vertical sides while the new nitrate would immediately slump to its repose angle. (See figure.) It should be mentioned that there is some stickiness in the new fertilizer, but it is doubtful if it is sufficient to cause trouble in handling. It seems to be subject to hardening in storage but breaks up readily into its original form.

Beginning with the German Pommerania it is evident why the new product poured out of the hopper continuously so long as there was a free opening to the ground. This occurred even at the smallest setting while the common nitrate did not pour out at all, even when wide open.

In the case of the grain drill the new nitrate would pour freely at the setting shown in the data. This is because, as stated earlier, there is a gate opening and when this is sufficiently open there is opportunity for a clear passage to the ground. In fact, an examination of the grain drill data shows that the more the variable gate is opened, the faster the new nitrate is fed out in comparison with the common nitrate.

The potato and corn planters had no table to indicate calibrated rates of distribution so it was only possible to compare the two fertilizers. This was done by computing the ratio of the quantity of the new nitrate to the quantity of common nirate. The agreement of the data for these two machines is surprisingly close, although the two fertilizers show wide differences. The two machines are unlike in construction and neither is probably as typically a forced feed as the common finger feed.

Apparently the designers of these machines used to advantage certain qualities of fertilizers which make them hard to handle. For example, stickiness of common nitrates has made it unnecessary to take precautions to prevent free pouring. For common nitrates there are about four qualification for the ideal feeding device. First, there should be sufficient agitation in the hopper to keep fertilizer on the feeding mechanism. Second, it should be a positive, forced feed type. Third, there should be a device for keeping the fertilizer from clinging to the feed and clogging it up. And fourth, the entire distributor should resist corrosion.

The new nitrate offers some new problems while it promises to solve some of the worst of the old problems. In order to use the new nitrate it is best to recalibrate the old equipment. Those distributors which resemble a gravity type of feed will have to be redesigned or adjusted to prevent free pouring. Both of these are simple matters, as judged by designers.

The old problems involved in distribution appear to be largely eliminated by the physical qualities and texture of the new nitrate. It is not extremely sticky and has a small angle of repose which probably does away with the need for any agitation in the hopper. This property should likewise make clogging a rare occurrence. It should obviate the need for cleaning devices on the feeding mechanism and perhaps simplify the design of the mechanism as well. It may or may not decrease corrosion but it simplifies that problem a great deal since it is very easy to clean out whatever residue is left when through using. On the whole, the development of a sodium nitrate with such satisfactory physical qualities promises to be a long stride toward better, cheaper and more efficient fertilizer distributing machinery. If all commercial fertilizers can be similarly granulated, or otherwise made more adaptable to machine handling, the solution of the whole problem of distribution should be considerably simplified for the engineer.

An Agricultural Engineering Experimental Farm in England

A 600-ACRE farm for the experimental application of power and machinery on a large scale is soon to be available to the Institute of Agricultural Engineering, University of Oxford, according to "The Implement and Machinery Review," of London.

The farm is to be fully equipped with all classes of farm power equipment in an attempt to find where and how mechanical power is profitable. One interesting point stated is that a specially skilled type of labor with something more than a smattering of mechanics will be employed.

One experiment already planned is to determine the extreme limits of plowing speeds. The "Review" points out that while speeding up operations can easily be carried far enough to decrease the efficiency of the individual machine. other factors, such as decreased labor cost and overhead and increased ability to get the work done at the optimum time, have an important bearing on the overall efficiency of a given operation.

Canadian Experience With Farm Machinery[1]

By J. K. MacKenzie[2]

THE practices of agriculture as they at present prevail are partly the result of scientific investigation and partly the result of the mass experience of agriculture throughout the ages. Frequently this mass experience has been demonstrated to be of much more practical value than insufficiently digested scientific data. On the other hand, a great mass of superstition and fancy has passed as the most sincere truth and profoundest verity. This has retarded agriculture and is still doing so. Nowhere is this more marked than in the sphere of agricultural machinery. Ignoring for the present those philosophers who argue that man would be happier without machines of any sort or description, we can find many examples of how superstition and traditional hang-overs have retarded agricultural development. Agriculture remained in a state of dead calm as far as machine development was concerned from the days when history dawned till the middle of the eighteenth century when the first all-iron plow was built. People refused to use such a plow, as the wisdom accumulated from the experiences of 5000 years with wooden plows told them that the drawing of iron through the soil would have a sterilizing effect on it. The progress of the iron plow was slow, and this slowness probably retarded the development of the steel plow by several decades.

The first "combine" was built in Illinois almost 80 years ago. At this time nobody doubted the necessity of allowing wheat to sweat in the stack, and this unfortunate inventor was pursued by laughter to his grave. Many of us remember when the transition from stack threshing to stook (shock) threshing occurred, and can also remember the manifold prognostications of disaster that accompanied the change. The same drag has accompanied every new development in farm machinery. Some farmers break their land to cut up tough spots, to kill weeds and secure a good seedbed. Most farmers plow because land has always been plowed and for that reason it is the only right and proper thing to do.

Tough spots can be broken up by means other than plowing. Weeds can be killed easier by other methods and it is very probable that under many circumstances there are implements that make as good a job of preparing the seedbed as the plow can do, and can do it more economically. This leads us to one of the present phases of agricultural development, a phase wherein the plow is being subjected to severe scrutiny and its claim to prominence as the one indispensable and unreplaceable implement is in process of revision. The same skepticism of the old gods of agriculture is working manifold changes in all branches of agriculture. In regard to farm machinery the farmers have shown more initiative than a great many of their appointed leaders, and it behooves us to at least march abreast with them.

Since the fall of 1922 when a 12-foot combine was placed on this station farm for experimental purposes, attempts have been made to conduct a systematic investigation of the merits, not only of new machines and new devices, but to compare their performance as accurately as possible with the performance of the old implements. The work has been slow mainly by reason of the fact that there was no existent technique that might be followed. Plot methods were useless where the combine, the one-way disk or any other large implements were concerned. It became necessary to evolve our own methods as we went along. In some cases this involved a radical divergence from the commonly accepted procedure of experiment stations.

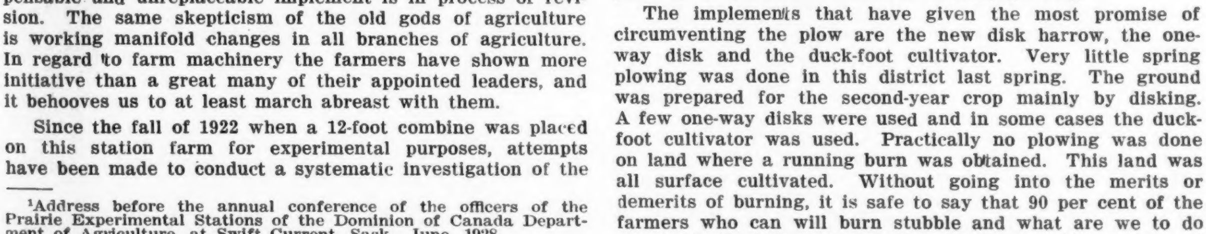
Our work with tillage implements has been determined largely by the availability of implements and the land necessary to conduct experiments properly. In this phase of investigational work we have endeavored to keep a little in advance of the public demand for information, but have not always done so, being plagued on one hand by the lack of space and on the other by the constant production of new machines and new devices that are designed according to their proponents to create a new heaven and a new earth. A township would be all too small an area on which to conduct an exhaustive inquiry into the merits of all the plows and combinations of plows with other tillage and seeding implements that have been offered for public use in the past six years. A full day would hardly serve to adequately relate the supposed merits of all of them. It has been necessary to choose those that appeared to offer some hope of success.

The introduction of a combine on any farm serves to upset the prevailing routine in more ways than is commonly appreciated. Where the old method of harvesting is followed, harvesting is the biggest job of the year and the means and method of harvesting usually determine the area to be harvested. One binder can be safely used to harvest a given area, probably not more than 225 acres in the average season. Hence farms are one-binder farms, two-binder farms or multi-binder farms. The coming of the combine has destroyed this arrangement. One sixteen-foot combine will readily harvest 500 acres in the time that the binder is harvesting 200 acres and with no more additional help. In effect harvesting has been speeded up till it is no longer the biggest job on the farm. The biggest job is now the preparation of the land for seeding and the operation of seeding. Plowing is now regarded by many farmers as an intolerably slow job. Hence the search for ways and means of accomplishing the plow's work without actually plowing.

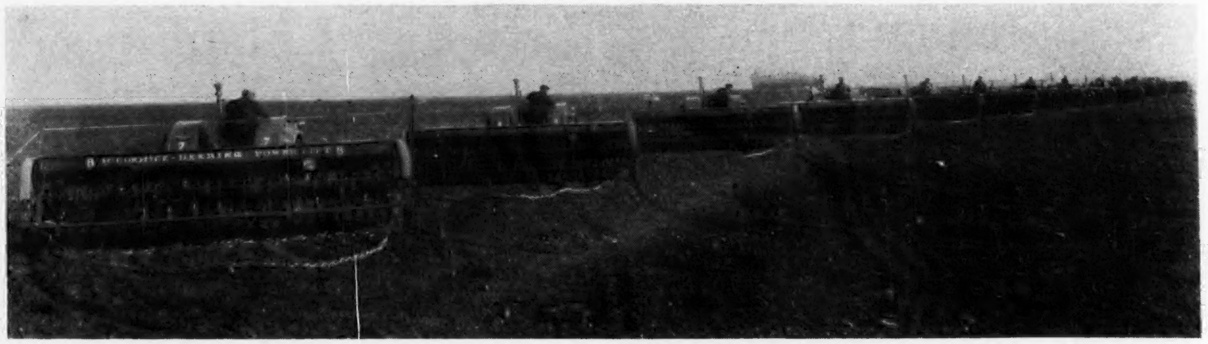
The implements that have given the most promise of circumventing the plow are the new disk harrow, the one-way disk and the duck-foot cultivator. Very little spring plowing was done in this district last spring. The ground was prepared for the second-year crop mainly by disking. A few one-way disks were used and in some cases the duck-foot cultivator was used. Practically no plowing was done on land where a running burn was obtained. This land was all surface cultivated. Without going into the merits or demerits of burning, it is safe to say that 90 per cent of the farmers who can will burn stubble and what are we to do about it? Doubtless if we have a short crop this year it will be blamed on the disk and the duck-foot. Short crops have

[1]Address before the annual conference of the officers of the Prairie Experimental Stations of the Dominion of Canada Department of Agriculture, at Swift Current, Sask., June, 1928.

[2]Assistant to superintendent, Dominion Experiment Station, Swift Current, Sask. Assoc. Mem. A.S.A.E.



The 14-ft. header shown in these two views, front and rear, is driven behind the 20-ft. combine and delivers its swath of grain to the supplemental conveyor which deposits the grain onto the platform canvas of the combine



On this 4,000-acre farm a fleet of twelve 15-30 tractors with 8-foot drills seeds from 500 to 700 acres a day

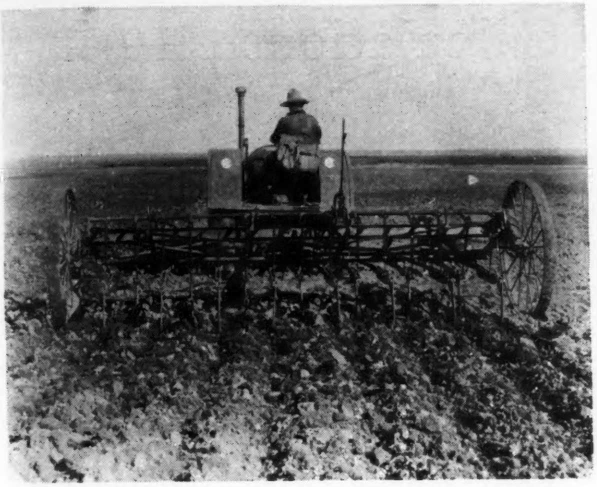
occurred in this district back in the days when the duck-foot was an appurtenance of a barnyard fowl and the disk was used solely to cut up new breaking or to maintain the alleged moisture-saving dust mulch on the summer-fallow. The plain truth is that disking, cultivating and similar practices are quicker and much more economical in the matter of preparing land for the second-year crop. Earlier seeding, apart from its effect on the current crop, enables earlier working of the current year's summer-fallow and therefore has a beneficial effect on the summer-fallow crop that may well offset any loss in yield on the second-year crop. We are not yet in a position to speak on the effect of those practices on yields. The matter of comparative costs is much more readily obtained. Dynamometer tests show the disk in first place, the cultivator and one-way disk contending for second place and the plow a long way behind. Ten hp.-hr. exerted on a one-way disk will cover 2.61 acres, cutting to a depth of 4.5 in. The same power will single-disk 6.9 acres 2.5 in. deep. It will plow with a moldboard plow to a depth of 6 in. 1.25 acres and will cultivate with a duck-foot cultivator 2.38 acres. The cost of a horsepower-hour is the same in all cases, being 7.64 cents, so if the work done was equally efficient in all cases then the disk would be a long way in the lead. Unfortunately the disk does not cultivate all the surface, it does not kill all the weeds and it does not penetrate well in hard ground. It cuts deep in soft ground and rides over the hard spots. If the surface is trashy it will not work well. On clean land that is free from hard spots it does good work and does it at a very low cost.

The same objections in a lesser degree apply to the one-way disk. This implement will, if sufficient power is exerted, work in hard land. Trash such as stubble and weeds apart from very bushy Russian thistles do not hinder its operation and after seeding the land can be harrowed if necessary. This can rarely be done on ground worked by the disk harrow. The duck-foot cultivator is primarily a summer-fallowing implement and does not do a good job in stubble of any thickness by reason of the tendency of the stubble to gather on the shanks. Apart from the matter of economy and speed of operation, surface working for the second-year crop has a definite appeal to farmers on weedy land. Particularly is this true where the summer-fallow is plowed. During the summer-fallow year the top 3 in. of the furrow slice is fairly well cleared of weed seeds. The bottom 3 in. are not. Spring plowing would merely bring up a fresh lot of viable weed seeds to pollute the second crop. It has been found that on land where all the soil is polluted with weed seeds that a cleaner second crop follows surface working than follows plowing.

In regard to seeding new ideas are at work. In general it may be said that the new ideas involve combining the separate operations of spring cultivation of summer-fallow and seeding into one operation and combining the preparatory work for the second-year crop, whether plowing or surface working with the operation of seeding. The implements necessary for this combination are known as cultivator-drills, seeder-plows and plow-drills. They are supposed to serve two functions: Economy of time and the performance of a better job which will be evidenced by an increased yield. As the operation of seeding is coincident with the working of the land it is conceivable that if the germinated weeds are killed at the time of operation then the seed grain has at least an even chance with the ungerminated weed seeds. The claim of economy is more difficult to determine. The cultivator-drill has naturally a heavier draft than either the cultivator or drill, but under special conditions of soils it does good work. The necessity of harrowing in order to level down the ridges reduces the economy somewhat, but where harrowing after seeding is generally practiced this point is of no importance. The seeder-plow plows a shallow furrow 6 in. wide and broadcasts the seed in the furrow. Its principal function is to seed the second-year crop, but it can also be used for summer-fallowing and seeding the summer-fallow crop. The operation in all cases is slow and its use should be confined to the lighter soils where stones are infrequent. On the lighter lands the seeder-plow has been used as a universal implement. It plows and seeds the second-year crop. It plows and cultivates the summer-fallow in two or three operations and finally it cultivates and seeds the summer-fallow in one operation. On farms of a half section or less this implement would appear to have a very promising future where the soil conditions are such that it can displace the seed-drill and the duck-foot cultivator entirely and the plow to a large extent. Its draft is about 800 lb. which is a fair load for six horses.

The plow-drill consists of a small seed-drill with a press-wheel attachment that is attached behind a gang-plow. Its draft is somewhat heavier than an equivalent width of an ordinary seed-drill, but this is probably due to the fact that the soil as turned up by the plow is usually wet and uneven. It appears to have possibilities in the drier areas. In wet land the furrow openers would likely clog. It adds about 300 lb. to the draft of a three-bottom gang-plow. Therefore, a tractor that could handle four plow-bottoms can only handle three when using the plow-drill. Both the plow-drill and the seeder-plow possess the advantage of placing the seed in freshly turned soil that has not had the opportunity of losing moisture by evaporation, at least not since burning. They do economize in the matter of human labor and undoubtedly can be used to advantage under special conditions of soils and soil moisture.

In summer-fallowing the tendency toward speedy operation is evident. Many farmers now disk all their summer-fallow land immediately after seeding is finished. This serves to cover surface weed seeds and retards those that have already germinated. The subsequent treatment depends on summer conditions, but usually the land is plowed. The one-way disk affords an opportunity of doing in one operation the work that is done by the disk and plow. The one-way disk can cut to a depth of 5 or 6 in. provided sufficient power is used. When operated by a tractor a ten-foot machine can cover 25 acres per day, which, on any ordinary farm, will do away with the necessity of disking to retard weed growth. The soil can be cut deep enough to make plowing unnecessary and it is left in such condition that the duck-foot cultivator can be used just as well as after the plow. It does not completely invert the soil nor does it cover up the stubble to any great extent, and thereby may be a factor in spreading sawfly damage. On the other hand, the amount of summer-fallow that is plowed before the sawfles emerge is usually very small.



Doing a job of summer fallow with a field cultivator equipped with duck-foot shovels

The one-way disk appears to have great possibilities on the lighter soils for the open plains. On heavy clay it sometimes balls up completely and on the looser soils of the park lands it pushes the soil in front of the disk.

For the subsequent working of the summer-fallow the duckfoot cultivator is largely used but there are several rivals. The rod-weeder and variations of the same idea such as the safety razor and the Oregon slicker have been used with a degree of success under special conditions. Where the soil is not too heavy and is reasonably free from stones all these devices work well. The charge has been made that they encourage soil drifting and it is very likely true. This can be partly overcome by ridging up the summer-fallow with the duck-foot in the fall.

In harvesting machinery we are in the midst of a momentous change, a change that is in process of revising not only harvest practices but the practice of the entire farm. Finally it may result in the adoption of a new unit farm area. There is no need now to speak of the possibilities of the combine, nor of its performance and economy of operation. The machine has demonstrated that under a wide range of conditions it can harvest and thresh grains at approximately half the cost of the same operations when performed by the binder and separator. In six years' experience we have found only one set of circumstances wherein the binder and separator secured more grain from a given area than did the combine. The combine was able to cut crops in 1927 that were so badly damaged by frost that the cost of harvesting by the binder and separator would not have been offset by the return for the crop.

There have been some significant developments in methods of harvesting since the advent of the combine. These are:

1. The header barge which makes a small stack. The stack is afterwards moved to the separator by means of a buck-rake or is threshed in its original position by the combine.
2. The swather which is usually an auxiliary of the combine. This lays the grain in swaths which, when dry, are picked up by a special pickup device attached to the combine.

It is impossible to give anything but qualified opinions on the merits of these systems, but it is important to know just what is likely to happen under any given set of possible conditions. It is a significant fact that practically all the implement companies now manufacturing combines have swathers on the market or are experimenting with them. At least half of the farmers who have given provisional orders for combines have included the swather and pickup in the order. It would appear that some definite knowledge on the swather would be of value.

Twenty swathers were used in Saskatchewan in 1927. They were mainly located on the heavy gumbo lands where the advent of rust in heavy green crops occasioned the fear that the crops would not ripen to the stage where the straight combine could be used. In general they did good work. The cost of harvesting by this method is about 35 cents an acre higher than that of the straight combine.

The header-barge used either with the combine or the separator has had good results in two instances that we have investigated but was a failure in one case wherein the stacks were soaked completely by rain and had to be scattered on the ground to dry.

This phase of harvesting remains open for investigation. The related problem of drying damp or tough grain has been practically untouched. The fear of damage while waiting for the crop to ripen to the stage where the combine can be used has lead many farmers into considerable difficulty. In some cases the loss sustained offsets the advantage gained by the operation of the combine. It is a difficult matter to procure a sample of grain from a standing crop that will represent with any accuracy the moisture content of the whole. The matter of grain drying should be thoroughly investigated. It has been done in a small way in the eastern states, but neither their peculiar problem nor the methods used to overcome it are applicable to our conditions.

In conclusion I would say that this work standing as it does between the farmer on the one hand and the manufacturers of implements on the other is one of vital importance to both. In hardly any other phase of their activities do the experiment stations possess such an opportunity of serving the agricultural population. In the last analysis it is found that farmers desire above all things else to make a living and some money if possible. Without machinery a low grade living would be possible, but the making of money by farming would be practically impossible. The prairies would still be a grazing ground but for adequate machines. Is it safe to say that we have gone far enough and that any forward advance will be disastrous? A similar prediction was doubtless made when the turkey-wing cradle with its maximum capacity of four acres per day gave place to the reaper and binder. It has been said that on many occasions that overproduction has caused loss to Western Canada. I cannot speak for all agricultural products, but in regard to wheat expensive production has cost us a great deal more than overproduction. Anything therefore that reduces the cost per bushel of wheat even by a fraction of a cent is well worthy of investigation.

Fighting Fires and Preventing Dust Explosions with Flue Gas

THE use of inert gas, or flue gas, piped from the furnaces of manufacturing plants for use in preventing fires and resultant dust explosions in grinding equipment should be seriously considered wherever the hazard exists, according to engineers of the Bureau of Chemistry and Soils of the U. S. Department of Agriculture.

Of thirty explosions occurring in feed-grinding plants during a 20-year period, eighteen originated in the grinding equipment where it was impossible to prevent the formation of dust clouds or to eliminate sources of ignition. Experimental work by the department engineers has shown that it is practicable to use inert gas for flooding the inclosures of the grinding equipment and diluting the oxygen content to such a point that fires or explosions can not take place.

Although the investigations were conducted in feed-grinding equipment, the results suggest many other possible uses for inert gas as a fire preventive. A modern development of this fire-extinguishing principle is the storage of compressed inert gas in tanks with distributing pipes which lead to the most likely sources of fire and quick-acting valves to release the gas. Such equipment has been used on ships and also in factories. A portable extinguisher consisting of a small tank of carbon dioxide under pressure has recently been placed on the market.

Inert gas, especially carbon dioxide, has many advantages over other fire-fighting mediums since it will not injure metals, fabrics, food products, or other perishable materials. Neither does it freeze or deteriorate, and as it does not conduct electricity it can be used to extinguish fires in electrical equipment.

Simplified Pitot Tube Calculations on Air Ducts and Air Piping

By Charles A. Bennett[1]

MANY engineers have difficulty when confronted with making air-volume calculations in the ducts or piping systems of fans and blowers. With ordinary care, using a calibrated pitot tube and sensitive gages, it is not difficult to secure accurate readings in ducts and air pipes. It is assumed that the agricultural engineer is familiar with methods of taking such readings. If not, it is suggested that he refer to any college text book on ventilation, to the "Standard Test Code" promulgated by the American Society of Heating and Ventilating Engineers, or to the several pamphlets thereon which are distributed by manufacturing concerns such as American Blower Company, B. F. Sturtevant Company, and others.

For determining the volume of air in cubic feet per minute, we are interested in the "velocity pressure" or "velocity head" reading of the pitot tube.

The basic formula used is

$$V_s = \sqrt{2\,gh} \qquad (1)$$

in which V_s = velocity in feet per second, g = acceleration due to gravity (32.16 ft. per sec.) and h = head in feet.

To convert volume and velocity into feet per minute, and velocity heads into inches of water, let

V = velocity in feet per minute

h' = head expressed in inches of water

W = weight of one cubic foot of atmosphere at the test conditions of temperature, humidity and barometric pressure

$$k = \frac{\sqrt{1}}{W} = \sqrt{\text{cu. ft. per lb. of atmosphere}}$$

(See Figs. 1 and 2). Then Formula 1 may be reduced to

$$V = 1096.2\ k\sqrt{h'} \qquad (2)$$

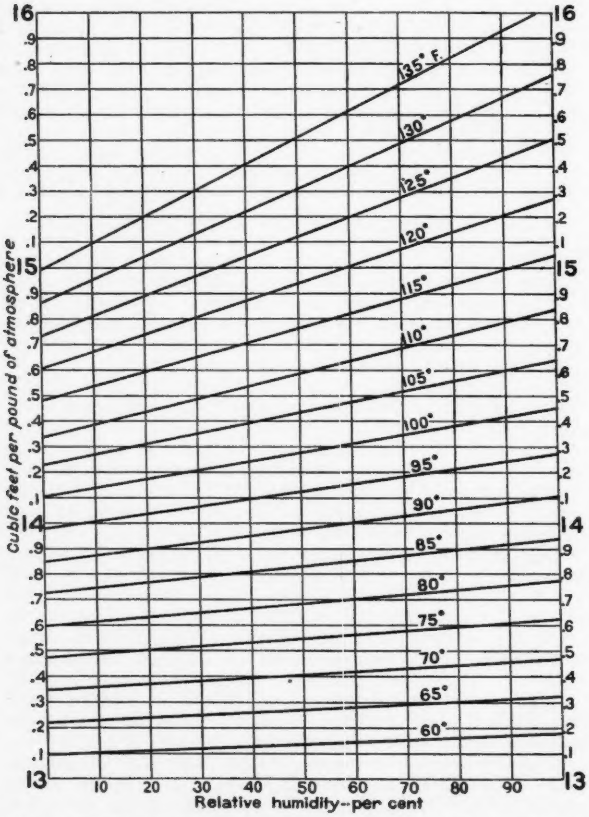
Assuming the atmospheric condition as 70 deg. F. 70 per cent relative humidity, and 30 in. barometric pressure, this becomes

$$V = 4012\sqrt{h'} \qquad (3)$$

It should be kept in mind that W is the weight of one cubic foot of atmosphere. Atmosphere is composed of dry air and water vapor. The higher the relative humidity, the greater will become the velocity under conditions of constant velocity head. Values for W may be obtained from the tables of the United States Weather Bureau, or may be calculated. Figs. 1 and 2 give the cubic feet per pound of atmosphere under many conditions of temperature at 30 in. barometric pressure. From these

$$W = \frac{1}{\text{cubic feet per pound}}$$

[1]Associate mechanical engineer, division of agricultural engineering, U. S. Department of Agriculture.



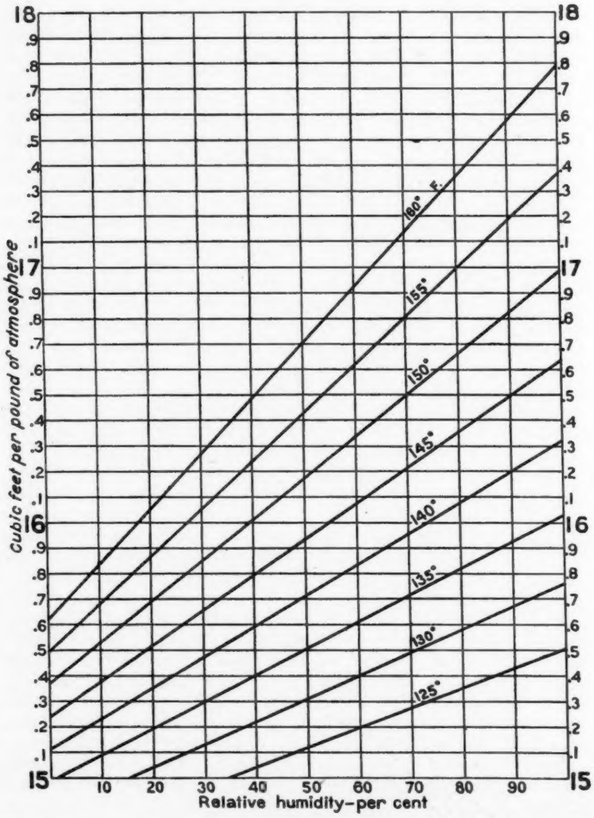


Fig. 1. (Left) Air volume chart (Part 1) showing the number of cubic feet in one pound of atmosphere at various temperatures and relative humidities. Fig. 2. (Right) Air volume chart (Part 2) showing the number of cubic feet in one pound of atmosphere at various temperatures and relative humidities. On these charts "Atmosphere" is designated as the resulting mixture of dry air and aqueous (water) vapor

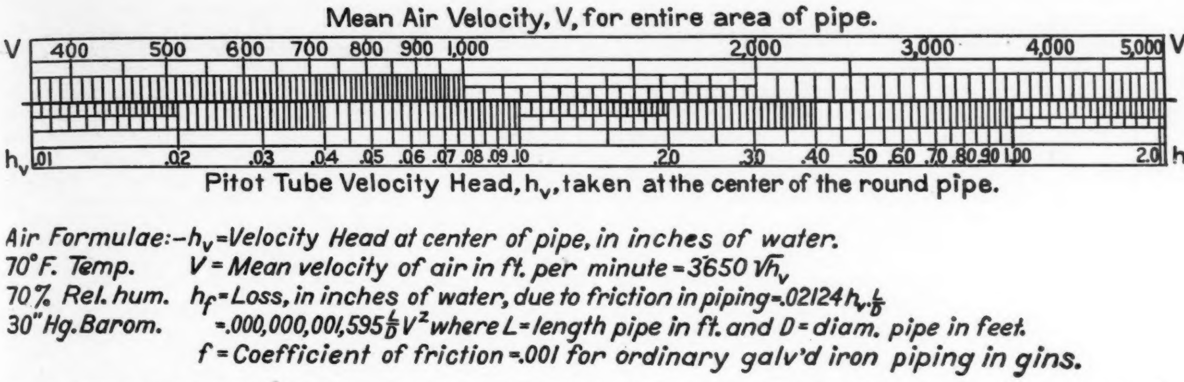


Fig. 4. Scale of mean air velocities in feet per minute, reading direct from velocity heads in inches of water, for pitot tube tests on round pipe

Having determined k, substitution in the following formula gives the basis of using the pitot tube readings to find the velocity in feet per minute in a duct or fan piping system. From many tests, the United States Navy has found that the mean velocity for an entire duct (round or its equivalent) is 91 per cent of the velocity at the center of the pipe. In agricultural engineering work most of the readings will be taken with a pitot tube at the center of the pipe, hence Formula 2 becomes

$$V = 997.5 \ k \sqrt{h_v} \qquad (4)$$

where h_v = velocity head at the center of the pipe.

Table I gives values for 997.5 k. Graphs from which can be read the mean velocity of the atmosphere in feet per minute within the pipe will enable an engineer to make the entire calculation on the spot, concurrent with the pitot tube readings.

Fig. 3 illustrates the graphic method which greatly simplifies the pitot tube calculations. Double logarithmic cross-section paper should be used, such as Dietzgen No. 378-A or Keuffel & Esser N-355-52 R, from either of which blue prints may be made for field use. Given conditions such as above described in Formula 3 and reducing these to use for a pitot tube reading at the center of the pipe, will give us

$$V = 3650 \sqrt{h_v} \qquad (5)$$

Mark off the base of the cross-section scale so that it reads from 0.01 to 1.0 and let this represent the pitot tube readings in inches of water as taken at the center of the pipe. Ordinates on the chart will then read from 100 to 10,000 for the velocities in feet per minute.

On Fig. 3 is delineated the graph for conditions as given for Formula 5, namely, $V = 3650 \sqrt{h_v}$, which conditions were 70 deg. F., 70 per cent relative humidity, 30 in. barometric pressure.

In case it is desired to have special charts or scales for several conditions, Fig. 3 may be used to produce a direct-reading scale such as Fig. 4. This is made by laying tracing cloth diagonally upon Fig. 3, and then rectifying the two intersecting scales upon the base line. In work where there are constant or average conditions to be met continually, Fig. 4 will be found very useful for field calculations.

By use of graphic solutions such as these, the difficulties with pitot tube readings are eliminated, and the engineer may not only make complete findings on the test grounds, but he is able to search into the causes of trouble if his results show that the volumes per minute are not what he believes they should be.

With such charts, it is easy to instruct assistants in making accurate observations, so that the engineer is free to follow up other details of the investigation.

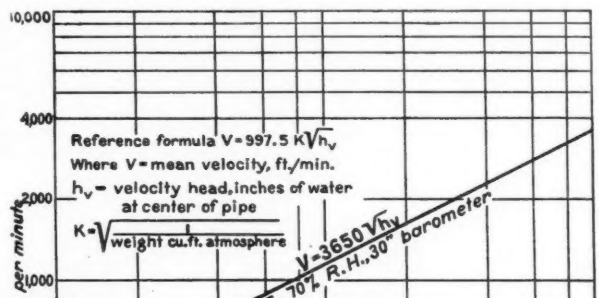


Fig. 3. Chart for calculation of mean velocities in fan ducts. Total cubic feet of atmosphere per minute = mean velocity x area of pipe in square feet

TABLE I. For Use With Formula 4V = 997.5 k$\sqrt{h_v}$

Atmospheric Conditions			
Temperature, degrees F.	Relative humidity	Barometer pressure	Value of 997.5 k[1]
	Per cent	Inches	
60	0	30	3606
60	50	30	3615
60	100	30	3621
70	0	30	3645
70	50	30	3653
70	100	30	3661
80	0	30	3679
80	50	30	3691
80	100	30	3703

[1]By slide rule from Figs. 1 and 2.

U.S.D.A. Studying Farm Fires

THE chemical engineering division of the Bureau of Chemistry and Soils of the U. S. Department of Agriculture is making a special study of farm fires with a view to the development of control and prevention measures. In this work the Department is cooperating with practically all national organizations interested in farm fire prevention. The Department has leadership in the work of the Farm Fire Protection Committee of the National Fire Protection Association, on which committee the National Association of Mutual Insurance Companies is represented. The committee after a careful survey, is of the opinion that the annual loss from fires on farms and in rural communities is approximately $150,000,000, and that about 3,500 lives are lost every year from farm fires. These losses are so great that any national effort to reduce them would be amply justified.—David J. Price.

The Reaction to Mr. Hoover's Stand on Corporation Farming

GENERAL surprise and almost unanimous approval were the two reactions uppermost in the minds of farm paper and many newspaper editorial writers when the stand of Herbert Hoover, Republican nominee for President, on the subject of corporation farming was learned from his acceptance speech, if one can judge from the comments made in editorial columns.

The "Prairie Farmer" of Chicago believes: "The fear that Mr. Hoover might be attracted by the fallacious arguments in favor of corporation farming is allayed by his statement that 'The farm is more than a business—it is a state of living. We do not wish it converted into a mass production machine. Therefore, if the farmer's position is to be improved by larger operations, it must be done not on the farm but in the field of distribution."

Similarly, "Wallace's Farmer" of Des Moines believes that "Mr. Hoover's statement, 'Farming is and must continue to be an individualistic business of small units and independent ownerships,' and that 'the farm is more than a business; it is a state of living,' is likely to be commended. It indicates a different point of view than the one heretofore credited to the Republican candidate."

In the opinion of Senator Arthur Capper, publisher of Capper's Farm Weeklies, Mr. Hoover's statement on the importance of working out agricultural relief and the importance of individual ownership shows his "sympathetic understanding of the farm situation." Senator Capper quotes the following paragraph from Mr. Hoover's address to illustrate the Republican nominee's sympathetic attitude toward the agricultural situation: "The working out of agricultural relief constitutes the most important obligation of the next administration. I stand pledged to these proposals. The object of our policies is to establish for our farmers an income equal to other occupations; for the farmer's wife the same comforts in her home as women of other groups; for the farm boys and girls the same opportunities in life as other boys and girls. So far as my abilities may be of service, I dedicate them to help secure prosperity and contentment in that industry where I and my forefathers were born and nearly all my family still obtain their livelihood.

"Farming is and must continue to be an individualistic business of small units and independent ownership. The farm is more than a business; it is a state of living. We do not wish it converted into a mass-production machine. Therefore, if the farmer's position is to be improved by larger operations it must be done not on the farm but in the field of distribution. Agriculture has partially advanced in this direction through cooperatives and pools. But the traditional cooperative is often not a complete solution."

Another interesting comment by "Wallace's Farmer" on this same subject, which shows the attitude of many farm readers, is contained in an editorial commenting on the following statement from the Brooklyn "Eagle": "Many farmers lack the understanding to make use of modern methods and of the abundance of information which the public agency supplies. . . . City folks may well ask themselves whether the country owes relief to the poor farmer, or whether it ought not rather to find a way of relief from poor farming."

"Probably the readers of 'Wallace's Farmer,'" answered that paper, "produce corn and hogs more cheaply than any other large group of farmers anywhere in the world. Of course, they can still make many improvements, both in the art of corn growing and in the science of feeding the corn to hogs. Nevertheless, we are certain that the average farmer producing corn and hogs has increased his efficiency during the last thirty years, even more rapidly than any city industry of similar age. . . . This is especially true when we take into account the fact that the farms are run by several million independent managers. What would happen to the automobile business if there were a million different men, each producing two or three automobiles? Some of them would, of course, be much more efficient than others. Moreover, there would be no possible way of making the less efficient producers as effective as the more efficient. There have always been differences in men, and there always will be. By scientific research, experimenting, etc., it is possible to raise the efficiency of the entire group, but it is also true that methods of this sort widen the differences between the poor man and good man.

"We find that people who criticise agriculture for lack of efficiency are nearly always thinking about corporation farming. Like Thomas D. Campbell, the Montana wheat king, they look forward to the day when there will be agricultural corporations as large as U. S. Steel or General Motors.

"In addition, we would like to call the attention of the Brooklyn 'Eagle' to the fact that if our poor farmers were as efficient as our best farmers, the volume of agricultural output would be so great that corn would be selling at 20 cents a bushel and hogs for $3.00 a hundred. Moreover, the reason agricultural products are so unduly cheap today is because agricultural efficiency has been increased so rapidly during the past 15 years by the U. S. Department of Agriculture, the agricultural experiment stations, the county agents and the farm papers.

"We intend that the readers of 'Wallace's Farmer' shall be kept fully posted as to all new methods which make for increased efficiency. At the same time, we shall continue to warn the nation that the present agricultural problem is not a matter of lack of efficiency in production, but a lack of control in handling that production."

The attitude of many country weeklies in agricultural districts toward corporation farming is typified by the Newell "Mirror," a paper published in the heart of Iowa's heavy corn-producing area. After describing a corporation farm in Texas which employs 124 families as semi-tenants, and describing the excellent living conditions on the farm, where running water is provided and many of the conveniences which are not ordinarily found on a farm are available, this paper says: "All farm owners might not be as virtuous as this one. Living conditions on some of the farms might not be as desirable as they are on this one. Once a small group of individuals had gained possession of most of the land in the country, they would bring pressure to bear.

"For centuries men laid down their lives to gain freedom from overlords. Are we to revert back to this type of civilization? Must the individual farmer go the way of the individual manufacturer who ran his own little shop, living a happy and contented life until—alas, he was crushed by big business and forced to don the clothes of a laborer?

"Furthermore, what would become of the small town merchant? If the landowner provided the supplies that the farmer needed, the small town merchant would be forced out of business. We have always felt that the farmers would be forced to unite in order to gain strength, but to surrender their liberty to the mercy of moneyed interests is one of the worst things that would happen.

"We once heard an eastern professor say in a lecture that the East was making every effort possible to reduce the West to a state of peonage. Such talk sounds like the harping of radicals, and yet money will do almost anything and our money is going East as fast as it can get there.

"Surely no energetic farmer would want to give up the opportunities and privileges of freedom and sell his labors to someone else that they might profit thereby. Farming is the great American industry and we want to see the farmer maintain the place in society which he deserves."

In the Jefferson County "Union," Fort Atkinson, Wisconsin, Mr. Halbert L. Hoard, the editor, also has an interesting comment on Mr. Hoover's plan to aid agriculture. According to Mr. Hoard: "Mr. Hoover's plan to aid agriculture is to get farmers and manufacturers together to discuss plans for higher crop prices. Mr. Hoover got nut and bolt makers to agree on sizes and threads. That was fine. He got lumber makers to agree on the lumber inch—fine again! But will he get manufacturers to agree on two-dollar potatoes and two-dollar wheat, or any other prices that will put crop raisers on a par with makers of farm machinery, automobiles and other farm needs?

However, there seems to be some difference between Mr. Hoover's ideas as expressed in his acceptance speech and the principles which he puts into operation on the 1,280-acre California farm which he owns in partnership with Ralph Meritt, Julius Barnes and Edgar Ricard, though possibly the trend in California is different from that in middle western and eastern agricultural regions. Max Stern, writing in the "New York Times" magazine, gives six principles which have led to the remarkable success of this farm project. According to Mr. Stern, these principles are intensive farming, diversification, machine or mass production, cooperation, direct marketing, the use of scientific information, and a seventh which is, really, "a Hoover hobby." This deals with the relation between the ranch and the hands. Between 45 and 300 men are employed, according to the harvest conditions. It is one of Mr. Hoover's express instructions that the laborer be housed, paid and treated in a way to contrast with the usual run of large western ranches. . . . The camps are houses or cottages equipped with showers, hot or cold running water, stationary tubs, concrete floors, and other conveniences. The wages are $75.00 a month upward for nine-hour days."

Dealing with the third principle, that of machine or mass production, Mr. Stern thus describes the methods used on the Hoover ranch, which is known as the Poso Land & Products Company: "Plowing, pumping, ditching, hauling, spraying, clearing, refrigeration—everything possible is done by farm machinery. The only mule cultivating is done in those places where the tractors would injure the crops. The result is an example of the saving of back labor such as will take the curse from farm work and some day will make it attractive enough to wean white Americans from factory jobs back to the soil. On the ranch today sixty men plus machines are doing what a generation ago it took 240 men to do. One man brings a crop up to harvest on twenty acres. It used to be one man to five acres. The toil of three men to every twenty acres is saved. On the Hoover ranch alone farm machinery is releasing for other jobs 180 workers.

In describing the fourth principle, or coöperation, one reason for Mr. Hoover's sympathetic attitude toward cooperative marketing operations is seen. According to Mr. Stern: "Although the ranch carries its own brand, "Poso," it belongs to three California cooperative marketing associations. It has taken the lead in organizing the cotton men of the South San Joaquin Valley, and furnishes the cotton growers' 'co-op' with a brand of cotton seed that has come to be standard in California and which is sold by the Farm Bureau to the other growers at cost. The Hoover Ranch produces this cotton at 15 cents a pound as compared with 20 cents for the same type in the South. California's state average for cotton is less than 500 pounds to the acre. Hoover's is 650 pounds."

Henry Ford, in an interview with Samuel Crowther of "The Saturday Evening Post," tells why he believes Mr. Hoover will do much to advance prosperity in agriculture. According to Mr. Ford, "New methods in farming are coming in as quickly as are the new methods in industry. New methods are adopted in both industry and agriculture only because they make a fuller use of materials and men than did the old methods.

"We have reached our present point without plan, but to go much further we need the opening of the country on so broad a basis that the government itself must aid. The old system is going out of business; there is no cure but the wisdom to welcome the new era, which will not alone solve our present problems but abolish them utterly.

"Herbert Hoover has the grasp not only of this country but of the world, and hence of this country's relations with the world. He is a young man; he belongs to the new era. He has the ideas of the new era and the proved ability to put them into practice. That is why I am for him."

EDITOR'S NOTE: (The foregoing "digest" was submitted by an A.S.A.E. member, who asked that his name be not used. It is published merely to give our readers the reaction of editors to Mr. Hoover's stand on corporation farming, and not in any way as implying either agreement or disagreement.

Farmer Hoover Applies Engineering

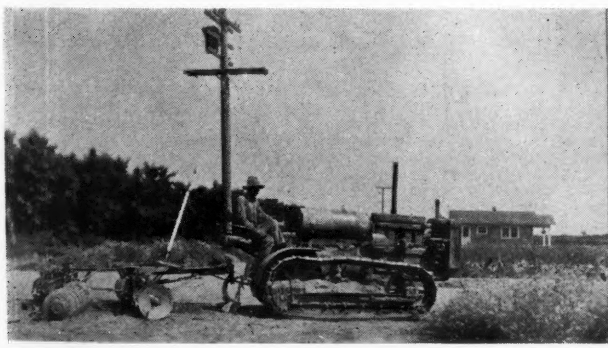
THE Herbert Hoover ranch, located near Wasco, California, some twenty-five miles northwest of Bakersfield, is this year one of the farms in the public eye. A recent visit by a member of the American Society of Agricultural Engineers brought out some interesting facts about its crops and methods.

There are 1280 acres of land in one piece in the Hoover ranch. The tract was purchased by Mr. Hoover about nine years ago, shortly after his return to the United States from war relief work. The land is all irrigated and under a high state of cultivation. Reclaiming it from a semi-arid region little more than a desert has been a real job of engineering. Deep wells had to be sunk to get water, not to mention leveling of land, building the irrigation system, and clearing and breaking.

Two large tractors and one small tractor handle the plowing, disking, tree and vine pulling on this farm. Potatoes are grown between the grape rows for a double profit from the acreage devoted to early table varieties of grapes. Peaches, figs, onions, alfalfa, etc., are grown on the remainder of the acreage.

A highly efficient farm manager is Harry Kilbourne, who combines practical and scientific knowledge of farming gained at the University of California and on western ranches. Crops are good this year, so that Mr. Hoover will find farming profitable regardless of how the political winds affect his fortunes.

The Hoover ranch is one of the most progressive farms in that section. The farm pays, and crops are marketed scientifically and cooperatively for profits. Incidentally, the former Secretary of Commerce is a good cooperator with neighboring farmers, his products being sold cooperatively.



(Left) Three tractors like this one are used on the 1280-acre ranch of Herbert Hoover near Wasco, Calif., which produces potatoes, cotton, peaches, grapes, onions, figs, etc. (Right) The office and manager's home on the ranch of the Republican nominee for President of the United States

Agricultural Engineering Digest

A review of current literature on agricultural engineering by R. W. Trullinger, specialist in agricultural engineering, Office of Experiment Stations, U. S. Department of Agriculture. Requests for copies of publications abstracted should be addressed direct to the publisher.

Silt in the Colorado River and Its Relation to Irrigation, S. Fortier and H. F. Blaney (U. S. Department of Agriculture (Washington, D. C.) Technical Bulletin 67 (1928), pp. 95, pls. 3, figs. 12).—A large amount of information of a preliminary nature is presented on the subject. It is pointed out that the Colorado River basin, with its varied physical features, is nearly as large as the State of Texas. The economic remedial measures feasible of application to the control of silt in the basin are (a) the storage of silt in a large reservoir located near the lower end of the canyon section, supplemented by the storage of silt in smaller reservoirs located on tributary streams, (b) the forming of settling basins and the installation of desilting structures at or near the intakes of diverting canals and (c) the exercise of efficient control over the growth and maintenance of native grasses and other vegetable covering.

The silt transported by the Colorado River consists of finely pulverized rock with a variable proportion of organic matter. Normally the specific gravity of this silt is 2.65, but the weight per unit of volume varies within wide limits. The finer silt, or that which passes a 200-mesh sieve, may be transported long distances in both natural and artificial channels if the mean velocity of the current exceeds two-thirds of a foot per second with a fair uniformity of silt content throughout any vertical section. Thus any velocity that is practical for an irrigation canal will carry in suspension most of the finer silt of the Colorado River.

It has been found that formulas applicable to the transportation of silk in the channels of foreign countries, particularly those of India, do not seem to apply to the water channels of the lower basin of the Colorado River. As closely as it can be estimated the normal quantity of silt transported annually to the lower end of the canyon section is 253,628,000 tons, or 137,000 acre-feet.

The opinion is expressed that the most feasible and economical means of solving the silt problem of Imperial Valley is to impound the river silt behind a high dam. It is estimated that about 20 per cent of the total load of silt in the Colorado River at Yuma, Ariz., is bad silt.

Welding Cast Iron Pipe (Public Works (New York), 59 (1928), No. 2, p. 52, figs. 2).—Investigations are reported on vee, collar, and combined vee and collar joints in cast iron pipes. The results indicated that the collar type joint for a pipe was not as strong as it was thought to be. Cross bending tests showed that the bronze collar joint is only about 55 per cent as strong as the pipe itself when De Lavaud pipe is used and only 42 per cent as strong when sand-cast pipe is used. In all cases failure occurred in the cast iron at the edge of the collar.

Bronze welding was found to produce no change in the chemical properties or physical structure of the cast iron adjacent to the weld. It was found, however, that the failure was due to a concentration of stresses in the cast iron next to the bronze collar. When cast iron was machined the machined surface was extremely difficult to tin, and there was very poor adhesion of the bronze to the surface, due apparently to the exposure of the graphite flakes. The machined surface was easily decarbonized by annealing to a bright red, after which the tinning operation became practically automatic. Tests made with the joints so prepared showed that the strength had increased to from 79 to 83 per cent of that of plain pipe, which is more efficient than any known mechanical joint.

Tests made with Class 150 De Lavaud pipe showed a breaking strength at shear-vee joints of 27,800 lb. per sq. in. in one case and 24,500 lb. in another. It was found that the most economical design was obtained by using a 40-deg. bevel with the additional shear area about 3/32 in. from the outside of the pipe wall. Little or no thickening or reinforcement is required, since the bronze has an ultimate strength greater than the pipe itself. The cost of the joint, including machining the pipe ends correctly, was slightly less than that of the collar type, but more expensive than the ordinary vee type.

Effect of Sulfur in Gasoline on Wrist-Pin Corrosion in Automobiles, S. H. Diggs (Industrial and Engineering Chemistry, (Washington, D. C.) 20 (1928), No. 1, pp. 16, 17).—Experiments are reported which showed that when using a gasoline containing 0.04 per cent of sulfur there was no corrosion of wrist pins and other moving parts, and that the water condensed in the crankcase contained no free acid but did contain some ferrous sulfate. When using a gasoline containing 0.151 per cent of sulfur the corrosion was very appreciable, and the water in the crankcase contained free sulfuric acid in small quantities. When using a gasoline containing 0.458 per cent of sulfur the corrosion was very serious and the crankcase water acid.

The conclusion is drawn that excessive sulfur in gasoline does cause serious corrosion of moving parts within the crankcase, especially in cold weather and when frequent stops are made. No evidence was obtained that such corrosion occurs in warm weather or to any great extent on parts that are kept continuously running during the day. There was likewise no evidence to indicate that anything other than sulfur in the gasoline is to blame. Sulphur combined in the lubricant is not to blame except in so far as it may actually be burned in the cylinder. The corrosion is caused in the first place by sulfuric acid, the formation of iron sulfide and oxide being secondary. The amount of corrosion is disproportionately greater for high sulfur than for low sulfur fuels.

Power Capacity and Production in the United States (U. S. Geological Survey, Water-Supply Paper 579 (1928), pp. II + 210, pls. 4, figs. 37).—This report includes an introductory statement by N. C. Grover and special papers on The Development of Horsepower Equipment in the United States, by C. R. Daugherty (pp. 11-112); Developed and Potential Water Power in the United States and Monthly Production of Electricity by Public-Utility Power Plants, 1919-1926, by A. H. Horton (pp. 115-202); and Growth of Water-Power Development in the United States, by R. W. Davenport (pp. 205-207).

New Seed Corn Curing Equipment Devised (Wisconsin Station (Madison) Bulletin 396 (1927), p. 74).—The results of one year's experiments by A. H. Wright and F. W. Duffee indicated that warm air if kept moving may be used at a temperature up to 130 deg. F. in curing seed corn without injury to germination, seedling growth, or maturation. Freshly harvested corn containing from 30 to 50 per cent moisture may be cured in 60 to 96 hours down to 12 per cent moisture without injury to germination and subsequent growth. The rapid drying of seed corn in bins appears to be satisfactory, decidedly cheaper, and much more certain than by the previous slow methods used.

The above conclusions are based on experiments in which hot air was forced through the corn with a fan at temperatures ranging from 80 deg. F. to 180 deg. F.; at various rates of drying ranging from 24 hours to 120 hours, and to various degrees of dryness ranging from 15 per cent down to 5 per cent. The resulting grain in every case was tested for germination, planted in the greenhouse and tested for seedling growth, planted in the field and tested for seedling growth, subsequent growth and maturation.

Combine-Harvester Studies at the Ohio Station (Ohio Station (Columbus) Bulletin 417 (1928), pp. 82, 83, fig. 1).—A comparative study of harvesting with the combine and the binder showed that the combine was satisfactory in oats even where the oats was flat on the ground. Several mechanical defects appeared when the combine was set to cut low. In the wheat it was necessary to raise the cutter bar to a 17-in. stubble and then to proceed rather slowly. No trouble was experienced in oats when cutting a low stubble. It was found that the binder was able to cut a considerably larger number of acres of wheat and oats per 8-hour day than the combine, owing to the necessity of the combine proceeding slowly to give it an opportunity to handle the straw. It was also impossible to take a full swath with the combine when harvesting wheat.

American Lubricants, L. B. Lockhart (Easton, Pa.: Chemistry Publishing Co., 1927, 3, ed., pp. XI + 408, figs. 22).—The purpose of this book is to aid the user and the buyer of lubricants in a more intelligent selection of oils and greases. The point of view throughout is that of the user rather than that of the refiner. Chapters are included on crude peroleum; the refining of petroleum; refined products; friction and lubrication; lubrication of internal combustion engines, automobiles, electrical machinery, steam cylinders and steam engines, steam railways, cotton mills and other textile mills, and miscellaneous plants and machines; physical and chemical methods of testing lubricating oils; lubricating greases; methods for testing and analysis of grease; animal and vegetable oils; methods of testing fatty oils; and specifications. Two appendixes are included.

Agricultural Engineering, B. J. Owen (In Agricultural Research in 1925. London: Royal Agricultural Society, England, 1926, pp. 44-72).—In this contribution from the Institute of Agricultural Engineering, University of Oxford, a review is given of the progress of agricultural engineering, particularly in Great Britain, during the year 1925. It contains sections on testing agricultural machinery, history of agricultural implements, land improvement, power, agricultural implements and machinery, and after treatment of crops.

Agricultural Engineering, B. J. Owen (In Agricultural Research in 1926. London: Royal Agricultural Society, England, 1927, pp. 74-120).—This review covers the subjects noted above for the year 1926.

Regulation of Quality and Standardization of Testing Methods, Ulrich (Technik Landwirtschaft, (Berlin) 8 (1927), No. 2, pp. 32-36, figs. 10).—This is an analytical discussion of testing methods which apply particularly to materials used in the construction of farm machinery.

The Effect of Steam Treatment of Portland Cement Mortars on Their Resistance to Sulphate Action, T. Thorvaldson and V. A. Vigfusson (Engineering Journal (Montreal) [Canada], 11 (1928), No. 3, pp. 174-179, figs. 8).—The results of a study conducted at the University of Saskatchewan under the auspices of a research committee of the Engineering Institute of Canada, with the financial support of the National Research Council of Canada and two commercial concerns, are reported. Expansion measurements of portland cement mortar bars were used to study the effect of steam treatment of mortars on their resistance to the action of the sulfates of magnesium, sodium, and calcium.

Treatment of mortars with saturated water vapor at 50 deg. C. (122 deg. F.) reduced their resistance to sulfate action. Saturated water vapor at temperatures of 75 deg. C. or above increased the resistance, the higher the temperature the more effective was the treatment and the shorter the time of treatment required. Steam treatment of mortars at the boiling point of water made them practically completely resistant to the action of sodium sulfate solutions and very materially increased their resistance to the action of magnesium sulfate solutions.

Immersion of mortars in hot water was nearly as effective in increasing the sulfate resistance as was treatment with steam at the same temperature.

The addition of tricalcium aluminate to portland cement speeded up the rate of expansion of its mortar in solutions of the sulfates of sodium, magnesium, and calcium. Steam treatment of these mortars was not as effective in preventing expansion in solutions of sodium and calcium sulfate as was steam treatment of mortars from the same cement without the addition of tricalcium aluminate.

It is suggested that the greatly increased resistance to sulfate action brought about by steam treatment of portland cement mortars is primarily due to the action of the steam on the aluminate in the cement. The speeding up of the hydration of the silicates by the steam treatment, while increasing the strength, is considered to be probably of secondary importance in relation to sulfate resistance.

Report of the Irrigation Engineer [of the Colorado Station], R. L. Parshall (Colorado Station (Fort Collins,) Report 1927, pp. 43-45).—This report deals with the progress of studies on the measurement of water, evaporation from a free water surface, evaporation losses from moist soils, and other related subjects. In the evaporation studies from free water surfaces a relation was established between a large evaporating surface and a standard buried pan in that the large reservoir loses about 75 per cent of that from a standard pan. Studies of evaporation from moist soils showed that for various types of soils, except the very heavy alkali adobe, the evaporation loss with the water table at 1 in. below the surface approximates very closely the loss from a free water surface.

Book Review

"Farm Buildings," the second edition of a text on this subject by W. A. Foster and Deane G. Carter, has recently been published. The subject matter has been revised, rearranged and largely rewritten to bring it up-to-date and present it in a more logical teaching order. As in the previous edition, a general study of farm buildings is given for students not advanced in theoretical mechanics and physics. No attempt is made to cover the theory of design. The chapters are Introduction—Plan Drawing, Farmstead Planning, Wood and Frame Building Materials, Cement and Concrete, Other Masonry Materials, Cost Estimating, Farm Building Construction, Framing and Roof Construction, Mechanics of Farm Buildings, Poultry Houses, Hog Houses, Hog-House Sanitation, Storage Buildings, Silos, Implement and Machine Shelters, Farm Barns, The Dairy Barn, The Horse Barn, Other Special-Purpose Barns, General-Purpose Barns, Ventilation, The Farm Home, Built-In Equipment and Home Utilities, Planning the Farmhouse, Farmhouse Construction, Specifications and Codes, and Reference Tables for Farm-building Design. A selected list of references on farm building subjects is included in the appendix. The book is one of the agricultural engineering series edited by J. Brownlee Davidson and published by John Wiley & Sons, Inc., New York. The list price is $3.00.

"Handbuch der Landmaschinentechnik," by Dr. Georg Kuehne (Mem. A.S.A.E.) professor of farm machinery at the Polytechnic University of Munich, Germany, represents a gigantic task, the completion of which will mean much for agriculture the world over. It is no less than the publication of a handbook of farm machinery. The first volume just issued has to do with horse-drawn and cable-operated tillage machines. Analyses are given of the following machines and parts, their principles of operation and adjustment; moldboard plows; coulters; subsoilers; heavy-duty cultivators; spike-toothed, spring-toothed, and disk harrows; surface and subsurface packers; smoothers; and cable-drawn plows, both the steam-engine-driven and the internal-combustion-engine-driven types, together with their accessories. Volume 1 has 132 pages and 313 illustrations and is published by Julius Springer, Berlin. The other three volumes promised are to cover the following subjects:

Vol. 2. The motor plow, the tractor, tractor implements. Machines and tools for seeding and cultivation.

Vol. 3. Harvesting machinery. Machines and devices for the threshing, cleaning, winnowing and storing of field crops.

Vol. 4. Machines for animal husbandry. Bulk handling of agricultural products. Devices and methods for testing agricultural machines.

A.S.A.E. Officers, Divisions, Committees and Sections

Officers and Council, 1928-29

William Boss, President, University Farm, St. Paul, Minn.
Geo. S. Knapp, First Vice-President
W. C. Harrington, Second Vice-President
Raymond Olney, Secretary-Treasurer, St. Joseph, Mich.
M. L. Nichols, Councilor
A. H. Hoffman, Councilor
Geo. W. Kable, Councilor
O. W. Sjogren, Junior Past-President
O. B. Zimmerman, Junior Past-President

Nominating Committee

J. B. Davidson, Chairman, Ames, Iowa
Dan Scoates G. W. McCuen

Professional Divisions

Power and Machinery Division

L. J. Fletcher, Chairman, 600 W. Washington St., Peoria, Ill.
R. U. Blasingame, vice-chairman

Rural Electric Division

E. A. Stewart, Chairman, 554 McKnight Bldg., Minneapolis, Minn.
E. E. Brackett, vice-chairman E. A. White, past-chairman

Structures Division

John Swenehart, Chairman, 2227 Commonwealth Ave., Madison, Wis.
J. L. Strahan, vice-chairman W. G. Kaiser, past-chairman

Land Reclamation Division

Q. C. Ayres, Chairman, Ames, Iowa
I. D. Wood, vice-chairman Geo. S. Knapp, past-chairman

Consulting Engineers Division

S. F. Morse, Chairman, Dalzell, S. C.
K. J. T. Ekblaw, vice-chairman W. P. Miller, past-chairman

College Division (Advisory Committee)

J. B. Davidson, Chairman, Ames, Iowa
E. R. Jones E. W. Lehmann S. P. Lyle H. W. Riley

Society Committees

GENERAL STANDING COMMITTEES

Finance Committee

O. B. Zimmerman, Chairman, 606 S. Michigan Ave., Chicago, Ill.
O. W. Sjogren William Boss

Meetings Committee

Dan Scoates, Chairman, College Station, Tex.
L. J. Fletcher Q. C. Ayres E. A. Stewart
John Swenehart J. B. Davidson

Publications Committee

J. B. Davidson, Chairman, Ames, Iowa
Geo. W. Iverson Fred A. Wirt P. S. Rose R.W. Trullinger

Committee on Code of Ethics

D. G. Miller, Chairman, University Farm, St. Paul, Minn.
E. V. Willard A. J. Schwantes

Committee on Student Branches

S. P. Lyle, Chairman, Athens, Ga.
R. A. Palmer J. G. Dent

Membership Committee

O. B. Zimmerman, Chairman, 606 S. Michigan Ave., Chicago, Ill.
J. B. Davidson W. C. Harrington W. G. Kaiser
F. N. G. Kranich E. R. Jones W. W. McLaughlin
Dan Scoates E. A. White

Standards Committee

Theo Brown, Chairman, 1325 Third Ave., Moline, Ill.
F. N. G. Kranich W. H. Worthington
O. B. Zimmerman C. O. Reed H. B. Walker

Research Committee

M. L. Nichols, Chairman, Auburn, Ala.
H. B. Walker J. F. M. Patitz Henry Giese
R. W. Trullinger A. H. Hoffman

SPECIAL COMMITTEES

Committee on Bureau of Agricultural Engineering

F. A. Wirt, Chairman, 1606 Park Ave., Racine, Wis.
M. L. Nichols Raymond Olney

Committee on International Agricultural Engineering Congress

S. H. McCrory, Chairman, 6811 Sixth St., N. W., Washington, D.C.
O. B. Zimmerman Kurt Grunwald H. B. Walker S. F. Morse

Committee on National Exhibit of Agricultural Equipment

Dan Scoates, Chairman, College Station, Tex.

Committee on Nomenclature

R. W. Trullinger, Chairman, Office of Experiment Stations, U. S. D. A., Washington, D.C.

Committee on Conventional Signs

J. R. Haswell, Chairman, State College, Pa.

Committee on Medals and Awards

O. B. Zimmerman, Chairman, 606 S. Michigan Ave., Chicago, Ill.
William Boss Raymond Olney

PROFESSIONAL STANDING COMMITTEES

1. POWER AND MACHINERY GROUP

Committee on Grain Drying

F. W. Duffee, Chairman, Madison, Wis. W. M. Hurst

Committee on Hay and Forage Crop Drying

Wm. Aitkenhead, Chairman, Lafayette, Ind.

Committee on Dairy Equipment

A. W. Farrall, Chairman, University Farm, Davis, Cal.
C. I. Gunness A. Jensen W. D. Hemker
M. Mortensen* O. F. Hunziker* J. T. Bowen*

Committee on Corn Borer Control

C. O. Reed, Chairman, Ohio State University, Columbus
R. B. Gray R. D. Barden A. L. Young

Committee on Row Crop Management

G. W. McCuen, Chairman, Ohio State University, Columbus
R. I. Shawl R. H. Wileman E. M. Mervine
F. R. Jones C. H. White B. R. Benjamin

Committee on Duty of Cultivating Equipment

D. B. Lucas, Chairman, New Brunswick, N. J.

Committee on Power Take-Off

F. N. G. Kranich, Chairman, Racine, Wis.

Committee on Combine Development

E. M. Mervine, Chairman, Ames, Iowa

2. RURAL ELECTRIC GROUP

Committee on Motors

W. D. Hemker, Chairman, State College, Pa.

Committee on Wiring and Equipment Installation

H. S. Hinrichs, Chairman, 1312 Harrison St., Topeka, Kans.
R. Boonstra E. A. Stewart

Committee on Rural Line Construction

C. P. Wagner, Chairman, 15 So. Fifth St., Minneapolis, Minn.

Committee on Nomenclature and Standard Practice

B. D. Moses, Chairman, University Farm, Davis, Cal.
W. C. Krueger G. W. Kable H. S. Hinrichs E. A. Stewart

Committee on Individual Electric Plants

J. R. Golden, Chairman, Hudson, Wis.
R. C. Cosgrove A. G. Tyler F. E. Fogle

Committee on Wind Electric Plants

Geo. Manikowske, Chairman, 517-11th Ave., S. E., Minneapolis Minn.

*Advisory member; not a member of A.S.A.E.

3. STRUCTURES GROUP

Committee on Design and Construction Practices for Animal Shelters

M. C. Betts, Chairman, 437 Cedar St., Takoma Park, Washington, D.C.
W. C. Harrington F. C. Fenton

(a) Subcommittee on Design of Animal Shelters

F. C. Fenton, Chairman, Manhattan, Kans.
H. B. White W. G. Ward C. S. Whitnah

(b) Subcommittee on Construction Practices for Animal Shelters

W. G. Harrington, Chairman, 131 Redfield Place, Syracuse, N. Y.
F. P. Cartwright H. Giese M. A. R. Kelley G. C. D. Lenth

Committee on Heating and Ventilating (Not Residences)

F. L. Fairbanks, Chairman, Ithaca, N. Y.
L. J. Smith J. L. Strahan T. A. H. Miller
M. A. R. Kelley

Committee on Fire Prevention and Protection

T. F. Laist, Chairman, Yellow Springs, Ohio
E. G. Lantz A. C. Page H. E. Roeth C. F. Miller

4. LAND RECLAMATION GROUP

Committee on Land Clearing

A. J. McAdams, Chairman, Columbia, Mo.

Committee on Run-Off from Agricultural Lands

C. E. Ramser, Chairman, Federal Building, Cape Girardeau, Mo.

Committee on Soil Erosion

C. K. Shedd, Chairman, Columbia, Mo.

Committee on Drainage of Irrigated Lands

M. R. Lewis, Chairman, P. O. Box 638, Baker, Ore.

Committee on Land Settlement

Geo. C. Kreutzer, Chairman, Bureau of Reclamation, Washington, D.C.

5. COLLEGE GROUP

Committee on Farm Mechanics in Secondary Schools

J. G. Dent, Chairman, University Farm, St. Paul, Minn.
M. A. Sharp E. E. Brackett G. M. Foulkrod
D. G. Carter A. Carnes H. E. Murdock
B. B. Robb (correlating member)

Committee on Teaching Methods

F. R. Jones, Chairman, College Station, Tex.
B. M. Stahl H. L. Wallace R. B. West D. S. Weaver
C. O. Reed (correlating member)

Committee on Agricultural Engineering Extension

L. A. Jones, Chairman, 49 Chestnut St., Takoma Park, Washington, D.C.
W. A. Rowlands J. P. Fairbank J. R. Haswell C. K. Shedd
M. R. Bentley J. T. Copeland I. D. Wood
L. F. Livingston (correlating member)

Committee on Farm Machinery Instruction

H. T. Barr, Chairman, Fayetteville, Ark.
H. P. Smith F. W. Duffee E. G. McKibben R. H. Driftmier
A. J. Schwantes (correlating member)

Committee on Advancement of Agricultural Engineering Education

Q. C. Ayres, Chairman, Ames, Iowa
R. U. Blasingame E. J. Stirniman C. W. Smith

Committee on Cooperative Relations

O. W. Sjogren, Chairman, Agricultural College, Lincoln, Neb.
S. H. McCrory Dan Scoates F. C. Fenton
J. B. Davidson (correlating member)

Geographical Sections

Pacific Coast Section

F. J. Southerland, Chairman, 245 Market St., San Francisco, Cal.
L. J. Stirniman, Secretary, University Farm, Davis Cal.

North Atlantic Section

W. C. Harrington, Chairman, 131 Redfield Place, Syracuse, N.Y.
O. B. Stichter, Secretary, 1047 Broadway, Albany, N. Y.

Southwest Section

G. E. Martin, Chairman, 223 Husband St., Stillwater, Okla.
R. W. Baird, Secretary, Stillwater, Okla.

Southern Section

S. P. Lyle, Chairman, Athens, Ga.
D. S. Weaver, Secretary, State College, Raleigh, N. C.

North Central Section

E. M. Mervine, Chairman, Ames, Iowa
H. B. White, Secretary, University Farm, St. Paul, Minn.

Who's Who in Agricultural Engineering


M. L. Nichols


R. W. Trullinger


O. W. Sjogren


R. B. Gray

M. L. Nichols

Mark Lovel Nichols (Mem.A.S.A.E.)— member of the Council of the American Society of Agricultural Engineers—is professor of agricultural engineering and head of the department at Alabama Polytechnic Institute. He is a graduate of Ohio State University, where he majored in agricultural engineering. On graduation he became associated with the Ohio Cultivator Company in experimental work. Afterward he farmed for three years, after which he taught agricultural engineering one year at the T. N. Vail Agricultural School in Vermont. From there he went to Delaware Agricultural College where he taught agricultural engineering for three years and at the same time secured a master's degree. For eighteen months he was extension specialist in agricultural engineering at the Virginia Polytechnic Institute and later tractor specialist for the Richmond branch of the International Harvester Company. In 1919 he was appointed to his present position. Perhaps his most notable contribution to the advancement of agricultural engineering has been in research. His work in soil dynamics is particularly outstanding. He has been very active in A.S.A.E. affairs. He was the first chairman of the Southern Section and he has served as chairman and member of the Research Committee and also on others.

R. W. Trullinger

Robert W. Trullinger (Mem. A.S.A.E.)—the Moses of agricultural engineering research—is assistant in experiment station administration (and agricultural engineer) of the Office of Experiment Stations, U. S. Department of Agriculture. He is a graduate in civil engineering from Iowa State College, from which he has also received a professional degree in agricultural engineering. For three years following graduation he was variously engaged in municipal, sanitary and agricultural engineering. He then became associated with the Office of Experiment Stations as specialist in agricultural engineering. From 1917 to 1919, inclusive, he was in military service, first as first-lieutenant and later as captain. Following his military service he again became specialist in agricultural engineering of the U.S.D.A. Office of Experiment Stations. Within the past year he was promoted to his present position. His untiring efforts to promote the development of research in agricultural engineering constitutes one of the most notable contributions ever made by an individual to the advancement of the profession. He has been especially active in A.S.A.E. affairs—as a member of the Council, chairman of the Research Committee and the Publications Committee, etc., and he has presented several outstanding papers before meetings of the Society, and to its publications.

O. W. Sjogren

Oscar Warner Sjogren (Mem. A.S.A.E.)—past-president and member of the Council of the American Society of Agricultural Engineers—is professor of agricultural engineering and chairman of the department at the University of Nebraska. He is a graduate in agricultural engineering of the University of Nebraska, and also has a professional degree in agricultural engineering from Iowa State College. He spent several summers supervising concrete and clay block construction in Nebraska, and was an instructor in the department of agricultural engineering for four years while working for his degree. He has been connected with that department continuously since graduation, first as instructor and later as assistant professor, associate professor, and professor. In 1918 he was appointed acting head of the department and in 1920 was made chairman of the department. One of his outstanding contributions to agricultural engineering has been in connection with his activities on the Nebraska Tractor Testing Board, the work of which has been of great value in tractor development. He is the author of a number of bulletins and of several technical papers before meetings of A.S.A.E. and other organizations. He served A.S.A.E. as its twentieth president during 1926-27. He has also served as chairman and member of several Society committees.

R. B. Gray

Roy Burton Gray (Mem. A.S.A.E.) is director of engineering and maintenance of the federal corn borer control forces, and is attached to the Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture. He is a native of Iowa and was educated in that state, receiving degrees in both electrical and agricultural engineering from Iowa State College. Upon graduation he entered the employ of the International Harvest Company, where he was attached to the experimental department and engaged in work on engines, plows, tractors, and trucks. He was later appointed professor of agricultural engineering and head of the department at the University of Idaho, which position he held for several years. He next engaged in teaching vocational agriculture in California. A few years ago he became associated with the U. S. Department of Agriculture Division of Agricultural Engineering. When the corn borer clean-up campaign was launched he was made assistant chief of engineering and maintenance, and was promoted to chief of that division about a year ago. He has rendered outstanding service in engineering as applied to corn borer control. He has served the Society in connection with a number of important committee activities. At present he is a member of the Committee on Corn Borer Control.

AGRICULTURAL ENGINEERING

Established 1920

A journal devoted to the advancement of the theory and practice of engineering as applied to agriculture and of the allied arts and sciences. Published monthly by the American Society of Agricultural Engineers, under the direction of the Publications Committee.

PUBLICATIONS COMMITTEE
J. B. Davidson, Chairman
G. W. Iverson P. S. Rose
F. A. Wirt R. W. Trullinger

The Society is not responsible for the statements and opinions contained in the papers and discussions published in this journal. They represent the views of the individuals to whom they are credited and are not binding on the Society as a whole.

Contributions of interest and value, especially on new developments in the field of agricultural engineering, are invited for publication in this journal. Its columns are open for discussions on all phases of agricultural engineering. Communications on subjects of timely interest to agricultural engineers, or comments on the contents of this journal or the activities of the Society, are also welcome.

Original articles, papers, discussions, and reports may be reprinted from this publication, provided proper credit is given.

RAYMOND OLNEY, Editor

Large Scale Farming

THERE is a lot of interest these days in large scale farming, corporation farming, industrialized farming, engineered farming, as it is variously called. Some people look upon it with a good deal of apprehension. Others condemn it outright. And there are those who think the industrialization of agriculture is just as logical, just as feasible, and just as certain as the industrialization of manufacturing and transportation.

Regardless of the point of view, we suggest that anyone concerned with this question of large scale or corporation farming take a good look at what has been happening. What is the trend today? In what direction is it headed?

What has mechanical power—in the shape of tractors, motor trucks, gas engines, electric motors—what has all labor-saving, cost-reducing equipment already done for agriculture? What has been the trend in farming— as to scale of operations, organization, management—as a result of the increased use of modern machinery? Has this trend differed from that in manufacturing and transportation? Should we expect it to differ? If so, why should it?

Judging from what some editors and others, who have spoken on behalf of agriculture, have had to say on this subject, we suspect they are against corporation or large scale farming pretty much because of sentiment. We cannot blame them for that. Most of us cherish a deep-seated sentiment for the farm and country life, especially if we were born and reared there, or have been close to its problems.

But sentiment will not cut much of a figure in future agricultural development. We are dealing here with economic forces; it is a hopeless task to attempt to turn them aside. This question will finally be decided on the basis of sound economics, whether we like the result or not. We may attempt to help the solution along, or we may do our best to retard or prevent what we think is the wrong solution. The inexorable working of economic law will eventually settle it willy-nilly.

What does the farmer think about large scale farming? We are not so much concerned about what other people think, but we are very much interested in what the farmer thinks. More than that we are interested in what he is doing about it. The tendency among the more progressive farmers—and they in our opinion constitute the real, honest-to-goodness agricultural leadership of America—is certainly not to reduce the scale of their operations, not with the mechanical power and modern equipment which they are making use of at a tremendously increasing rate.

These leaders are the ones we should watch. They are the pace-setters. What they as a whole do will probably be about right. And sooner or later the rest of the industry will follow their lead; it will have to.

Our best farmers don't seem to be scared of corporation or large scale farming; many of them are going to it.

Probably a good many editorials will be written, any number of speeches will be made, and countless hours will be spent in discussion on this subject of the big farm and the little farm, of the corporation farm and the individual family-owned and operated farm. But after all is said and done, isn't the acid test of the success of either the dollars-and-cents net return the owners receive for their labor and on the capital invested? If the one-family farm pays a good return on the investment, and if the total income is sufficient to enable the owners to maintain a reasonably high standard of living, that farm is a success. If the corporation farm pays the owners a satisfactory return on their investment, there is no argument about corporation farming being justified.

We will have corporation and other large scale farming enterprises, plenty of them—we have a good many now—and whether we will have more or less will be governed largely by the pressure of economic conditions and requirements. Also we will always have the small farm, on which the labor will be furnished entirely by the farmer and his family.

The main interest of the agricultural engineers, as it should be of everyone, is to help the people in agriculture get the highest possible return for their labor and the capital invested, so that they may take advantage of standards of living that are available to any section of our population.

Land Clearing Extension

THE LAND clearing group of agricultural engineers has been one of the most active groups in the profession. The result of its activity and constructive efforts has been to greatly advance the art of clearing land by engineered methods and equipment. It constitutes one of the most outstanding contributions in the realm of engineering as applied to agriculture.

America is now faced with the problem of having too much land producing crops. Therefore, it is not profitable at this time to bring additional cut-over lands under cultivation. This fact is fully recognized by the land clearing group represented by the Committee on Land Clearing of the American Society of Agricultural Engineers.

However, this should not be taken to mean that land clearing activity is at a standstill. The A.S.A.E. committee realizes that all agricultural states have a land clearing problem, but that "the only land clearing which is now being done profitably is the improvement of farms already under cultivation." Special attention is being given to the removal of obstacles, such as stumps and stones, to good cultivation. These obstacles are found on a large percentage of farms, and with the increased use of modern power machinery and the desirability of operating it at the highest possible efficiency, the need for removing stumps, stones, etc., from cultivated fields becomes increasingly important.

To stimulate interest in a continuing program of land clearing, the committee has outlined an extension project which it is recommending to state directors of agricultural extension and to land clearing specialists. While, at this writing, the committee's recommended project has been sent out but a short time, a splendid response is being received, indicating an enthusiastic interest in it.

Agricultural engineers in general will be interested in and responsive to this effort of the land clearing group to raise the efficiency of agricultural production by means of a comprehensive, sensible program of land clearing applied to land now under cultivation or on underdeveloped farms.

* * *

While agricultural engineers appreciate that reclaiming additional land areas by clearing, drainage or irrigation is not justified at present, it does not mean that the land reclamation group may be out of a job. On the contrary, this group will turn its attention to the greater improvement of land already under cultivation.

A. S. A. E. and Related Activities

Winter Meetings of A.S.A.E. Technical Divisions

THE programs of the meetings of the three technical divisions of the American Society of Agricultural Engineers to be held at Hotel Sherman, Chicago, December 4 to 7, inclusive, promise to be of outstanding importance to agricultural engineers and to the allied agricultural and manufacturing industries.

Power and Machinery Program

The coming meeting is fully expected to be the largest ever held by the Power and Machinery Division. A great deal of interest is being displayed in the subject of large scale farming. Both sides of this subject will be discussed. A strong program on the general-purpose tractor and the combine is assured. Several papers on specialized subjects are already being prepared by qualified persons.

The Power and Machinery program will be presented Tuesday and Wednesday, December 4 and 5. The entire day of December 4 will be devoted to a discussion of the present status and trend of large scale farming. It is proposed to schedule from five to seven speakers on this program, each man taking about one-half hour for his discussion, in which he will cover the use of machinery; need, if any, for new types or modifications; management and systems of maintenance; handling of labor; accounting systems used; marketing and financing.

The greater part of the forenoon session on December 5 will be devoted to a symposium on the general-purpose tractor. There will also be presented at this session a paper on studies of applying power to soil pulverization.

Three subjects will feature the afternoon session of December 5. These will be an organized discussion on the development of the combine and grain drying, a paper on the use of machinery in weed control, and a paper on the development and possibilities in corn harvesting equipment.

Rural Electric Program

The meeting of the Rural Electric Division will be held December 6. The program of the morning session will include papers on the following subjects: (1) Farmstead wiring, (2) wiring of farm buildings, and (3) motor installations.

The program of the afternoon session will include the following papers: (1) Installation of water systems, (2) feed grinding on the farm, (3) dairy refrigeration, (4) seed corn testing, and (4) ventilation by electric fans.

Structures Program

The meeting of the Structures Division will be held December 6 and 7. The program of this meeting will feature an address by a speaker of national prominence on the relation of beauty as applied to farm structures, more particularly farm houses. A paper will also be presented on the result of some outstanding research work in farm structures completed recently. A paper will also be presented by a qualified banker familiar with appraising on the relation of animal shelters to safe farm loans; the speaker who will handle this subject will be a person of national prominence.

Several other subjects of outstanding importance to the farm structures field are being arranged for presentation at this meeting.

Virginia Bulletin Honors McCormick

THE "BULLETIN of the Virginia Polytechnic Institute," Blacksburg, dated July, 1928, is devoted entirely to the addresses delivered May 1, 1928, at the unveiling of the marker erected in memory of Cyrus Hall McCormick, inventor of the reaper, on the old McCormick farm near Raphine, Rockbridge County, Virginia, by the Virginia Polytechnic Institute student branch of the American Society of Agricultural Engineers.

Studies Agricultural Engineering Research in the United States

N. P. Sokoloff, director, North Caucasian Regional Agricultural Experiment Station, and professor, Don Region Agricultural College, Rostov on the Don, U.S.S.R., is in the United States studying the farm machinery now in use here and also the research work on farm machinery which is in progress. He plans to visit many of the important agricultural experiment stations and farm machinery manufacturers.

Personals of A.S.A.E. Members

E. B. Doran, professor of farm mechanics and head of the department at Louisiana State University, has been granted a year's leave of absence. He will spend a year working for an advanced degree at the University of Illinois and at the same time take charge of the work of E. W. Lehmann, who is on a year's leave from the latter institution.

J. Fletcher Goss has resigned as assistant professor of agricultural engineering at South Dakota State College to take charge of agricultural sales of Caterpillar tractors and Holt combines for the Western Material Company, Sioux Falls, South Dakota.

Truman E. Hienton, project leader in rural electrification, and **Miriam Rapp**, home economics specialist, of Purdue University, are joint authors of circular No. 157, entitled "Electric Service for Light, Heat and Power," just issued by the agricultural experiment station of that institution.

E. W. Lehmann, professor of farm mechanics and head of the department at the University of Illinois, has been granted official leave of absence for one year starting September 1, to make field studies designed to open a way for a wider use of electricity on the farms of the United States. In cooperation with the Illinois Public Service Company he will first make a general analysis and survey of rural electrification of that company's territory. During the second half of the year he will be in Minneosta, Wisconsin, Indiana, Ohio, Pennsylvania, New York, Alabama, Texas, and Kansas, where he will study the plans of other companies for supplying electric service to farmers. The study will be a continuation of rural electrification investigations which his department has conducted for the past few years on ten Champaign County farms in cooperation with the Illinois State Electric Association.

J. T. McAlister, extension agricultural engineer, Clemson Agricultural College, will in the future devote full time to extension work and will feature farm power and machinery at the start. He has been relieved of his teaching work in agricultural engineering by D. W. Teare, an agricultural engineering graduate of Kansas State Agricultural College, with a master's degree from Iowa State College.

W. J. Parvis has resigned as agricultural research engineer with the U. S. Department of Agriculture to accept a position as rural electric engineer for the Northern Indian Power Co., Kokomo, Indiana. While with the Department of Agriculture he was working on corn borer control at Toledo, Ohio. His entire time now will be given to rural electrification.

C. K. Shedd, formerly extension agricultural engineer for Kansas State Agricultural College, has accepted a position as extension agricultural engineer for the University of Missouri, Columbia.

E. A. Stewart has resigned as associate professor of agricultural engineering at the University of Minnesota and pro-

ject director of the Red Wing Rural Electrification Project sponsored by the Minnesota Committee on the Relation of Electricity to Agriculture to become president of the Northwestern Public Utilities, Inc., 554 McKnight Building, Minneapolis.

J. E. Waggoner, research agricultural engineer of the A. & M. College of Texas and director of the Texas Committee on the Relation of Electricity to Agriculture, is author of bulletin 35, entitled "Electricity on Texas Farms," issued this year by the Texas Engineering Experiment Station, College Station, Texas.

New A.S.A.E. Members

M. A. Sharp, aassistant professor of agricultural engineering, Iowa State College, Ames, Iowa.

Charles P. Wagner, rural service engineer, Northern States Power Co., Minneapolis, Min.

Transfer of Grade

Fred C. Fenton, professor of agricultural engineering, Kansas State Agricultural College, Manhattan, Kans. (Associate Member to Member).

Harold C. Jackson, Jr., training for salesman, John Deere Plow Co., Moline, Ill. (Student to Junior).

Frank D. L. Jones, experimental engineer, Dain Mfg. Co., Ottumwa, Iowa. (Junior to Associate Member).

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the September issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Forrest D. Banning, rural electrification engineer, Florida Power & Light Co., Miami, Fla.

Ralph T. Filson, teacher of agriculture, Washington Union High School, Fresno, Calif.

Aubrey Lee Sharp, assistant to agronomist, Tela Division, United Fruit Co., Tela, Honduras, Central America.

Alfred J. Van Schoick, rural service specialist, New York Power & Light Corp., New York.

Employment Bulletin

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of AGRICULTURAL ENGINEERING. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Non-members as well as members, are privileged to use the "Positions Open" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

Men Available

AGRICULTURAL ENGINEER available. Seventeen years experience in the designing and manufacture of farm tractors, motor trucks, harvesting machines, and earth-working tools. Sales experience in United States, Canada, England, France, and Italy. Write for interview. MA-132.

AGRICULTURAL ENGINEER, graduate of Colorado Agricultural College in civil and irrigation engineering, with sixteen years experience in irrigated agriculture and land reclamation, desires position, preferably on the Pacific Coast. MA-154.

AGRICULTURAL ENGINEER desires position as general manager of large agricultural concern where initiative, ability and resourcefulness are required. Has knowledge of legal procedure and finance, has handled agricultural propositions employing three thousand men, speaks Spanish, recently carried out reorganization in Latin America for one of the largest banks in this country. Can furnish credentials as to character, integrity and sobriety. 40 years of age, excellent health, American native born, protestant, married. Will go anywhere but prefers continental U.S.A. MA-148.

Positions Open

AGRICULTURAL ENGINEER with college training and practical experience with tillage tools and seeding machinery wanted by a farm machinery manufacturer in the Middle West. Must be skilled draftsman and have designing ability. PO-132.

AGRICULTURAL ENGINEER wanted for position as teacher of farm machinery in a southern agricultural and mechanical college. Salary about $3000. Position has excellent opportunities. PO-135.

SERVICE MANAGER to organize field service, prepare instruction books, and repair parts list is wanted by power farming machinery manufacturer. Must be loyal, aggressive, and able to handle service men, dealers, and customers. Give full details of training, experience, references, etc., in first letter. PO-136.

MECHANICAL ENGINEER wanted by power harvesting machinery company in the middle west. Must be aggressive, loyal, ambitious, and capable of handling drafting room. Also must be able to cooperate with manufacturing department. State training and experience in first letter. PO-137.

AGRICULTURAL ENGINEER wanted by a steel products company to assist in the development of their line of sheet metal and steel articles for farm use. Must have good fundamental technical training and an understanding of agricultural practice, especially in the Northwest states. Duties will include some field work and investigation. The company has been established many years, is well rated and has excellent marketing connections. PO-138.

AGRICULTURAL ENGINEER wanted to do teaching and experiment station work in the agricultural engineering department of the Montana Agricultural Experiment Station and State College. The specific work will be in irrigation and drainage. Write H. E. Murdock, Bozeman, Montana.

MANAGER AND EXECUTIVE wanted to undertake the direction and execution of an agricultural development of 6,000 acres of land in Florida. Position calls for a man of wide experience in production of products which are possible to Florida and one whose practical experience is backed up by a reasonable amount of scientific knowledge. He must be a man whose reliability and integrity are beyond question and whose executive ability is of a high order. He must further have the faculty of doing things at the least possible cost. PO-139.

DESIGNERS AND DRAFTSMEN wanted. One of the leading farm equipment manufacturers is increasing its engineering personnel and desires to secure the services of two or possibly three designers and draftsmen, preferably those who had had tractor, implement, or allied experience. PO-140.

PRACTICAL FARMER wanted to team up his experience and labor with the land and operating capital of a farm owner in Guatemala. Prefer married man about thirty years of age, one who understands the raising of corn, wheat, garden truck, etc., and who also understands tractors and other farm machinery and can utilize modern equipment in a modern way. Traveling expenses can be advanced and ample farm operating funds provided. Profits split fifty-fifty. Write fully giving age, education, experience; send photograph. PO-141.

MECHANICAL FIELD REPRESENTATIVE for sales department wanted by a leading manufacturer of farm equipment. Will have charge of field organization throughout the company's branch house territory. As the work will be mostly in the Southern states a man familiar with Southern conditions is desired. Must possess qualifications to deal with salesmen as well as having engineering ability. PO-142.

AGRICULTURAL ENGINEER wanted to assist in teaching general agricultural engineering subjects, preferably one qualified along farm machinery lines. Should be qualified to take freshmen in a three credit course, stressing mechanics, electricity, hydraulics, etc., in as practical a way as possible. Minimum salary, $2400. This can be increased if right man is located. Address W. J. Gilmore, professor of farm mechanics, Oregon State Agricultural College, Corvallis.

AGRICULTURAL ENGINEER with a degree in agricultural engineering wanted to fill a vacancy in an agricultural engineering department of one of the state agricultural colleges of the Northwest. The work will be entirely in farm power and machinery, time being given about half and half to teaching and research. PO-143.

AGRICULTURAL ENGINEER wanted for instructor in farm buildings and conveniences or farm machinery. Farm and practical experience desired. Salary $2400 to $2800. Applicant should furnish personal and service record. PO-144.

U. S. CIVIL SERVICE OPENING

The U. S. Civil Service Commission announces an open competitive examination for associate land-clearing specialists ($3,200 to $3,700 a year). This examination is principally to fill vacancies in the Field Service of the Bureau of Public Roads, Department of Agriculture. A degree in engineering, agriculture or forestry, two years of responsible experience in land-clearing work, and an additional year of either practical experience or post graduate study are prerequisite. Applicants should secure and execute Form 2600 and have it on file with the Civil Service Commission at Washington not later than October 24, 1928.